# A Cloud Computing Based Learning Management Systems (LMSs) Architecture

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**Abstract:** LMSs are currently the main and important software tool for planning and underpinning contemporary e-learning. The LMSs cloud provides the true concept of e-learning where individuals can access the information required at any time and place using any computer. Therefore, large enterprises and organizations can take advantage of these applications to gain a competitive advantage. Moreover, this application applies not only to companies but also to the education sector. In this paper, we proposed cloud-computing based LMSs architecture from the following parts: Architecture, models of cloud, construction method, interface with the model and key benefits. Our results present a solution that is based on cloud computing and can be used for building a virtual environment both for teaching and learning.

## 1. INTRODUCTION

With the appearance of Web 2.0 and Web 3.0 and the rapid growth in Internet access users, many organizations have introduced new applications through the Internet in so-called cloud computing such as saving expenses or providing services to a larger sector of beneficiaries. E-Learning can be defined in many different ways learning and/or teaching in any broadcasted form in order to share knowledge throughout the world. (For example), the internet, intranet or TV signals, etc. This kind of learning has been in troduced into the Thai market for a while now, such as computer-assisted instructions, CD-ROMs, Web-Based Learning, on-line learning, distance learning via satellite or online video conferences, etc. The advantages of e-Learning have been widely covered. The main benefit would is be long distance learning via electronic media as the medium [6]. E-Learning systems consist of three parts; the learning management system (LMS), courseware and the technology which are the typical elements of e-Learning. However Courseware or contents via internet networks can expand rapidly out of control if it is not monitored correctly [7].

On the other hand, users can be free from the building and maintenance for e-learning system and specifically focus on the application of e-learning system, in order to improve teaching quality and management level. In this model, the construction of cloud computing systems is separated from thits usage, and through economic advantage, there are sufficient back-up and maintenance funds to build and feed an e-learning system, which can make e-learning system development into a virtuous circle. Thus, the emergence of cloud computing opens a new idea to further development for LMSs. [3] But the development of cloud computing is faces of which many critical issues, the most prominent is the security issue. With the growing popularity of cloud computing, the importance of security show gradual upward trend, and has become an important factor in the development of cloud computing. The main objective of this paper is to try to bring more clarity to the landscape about cloud computing security [8].

In order to review all these aspects, this paper is arranged as follows. In Section 2, we introduce the main definition and architecture of cloud computing, cloud computing deployment models advantages and disadvantages of cloud computing.

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Section 3 presents the definition and architecture of LMSs, features classification of the LMSs. Section 4 is devoted to describing the cloud computing based LMSs architecture. Section 4 is discussions the key benefits of cloud-based LMS architecture. Finally, there is a discussion and conclusion.

## 2. CLOUD COMPUTING:

### A. Definition and Architecture of Cloud Computing

Cloud computing "is a technology based on the transfer of processing and storage space for the computer to the so-called cloud, and is a server to be accessed via the Internet. In addition, cloud computing infrastructure is based on the advanced database. Cloud computing is derived from the term that represents the number of times the Internet is used as a network diagram. This is due to the presence of a database that provides services, and the cloud can be considered as a key and unique point of access to receive all requests from customers around the world [3].

Chia- Hu also known as cloud computing as a form of electronic computing that relies on its application to electronic computing resources instead of having local LAN servers or personal computers to handle the applications and software required. Cloud computing is similar and similar to network computing, a type of computing processing cycles are not used for all computers in the network to solve the complex problems of an independent machine [5]. Figure 1 shows the cloud-computing infrastructure.

The LMSs properties demonstrate the concept of cloud computing and describe the characteristics and structure of a cloud computing platform by taking into account the features of LMSs. Cloud computing is introduced to LMSs, the LMSs build a cloud, and the working model explores through it the following aspects: architecture and the method of building an external interface with a model [4].

Figure 1 shows the three services of cloud computing, where customers' basic needs are identified upon, and customers have the right to choose one or more of the desired services [5]. These three services are:

- *Software as a service (SaaS):* Cloud computing is more interested in end-user applications such as e-mail systems, CRM applications, shared software, and workflow management systems. In this class, software applications are used as basic online services rather than packaged software packages purchased by individual customers. Salesforce.com is one of the leading companies in this category. It is also more interested in end-user applications such as

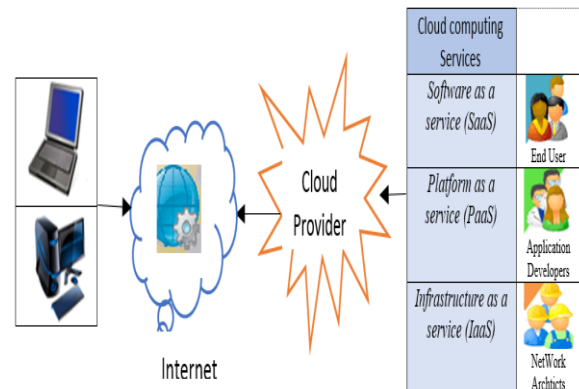email systems, CRM applications, shared software, workflow management systems, Office Web applications, etc.



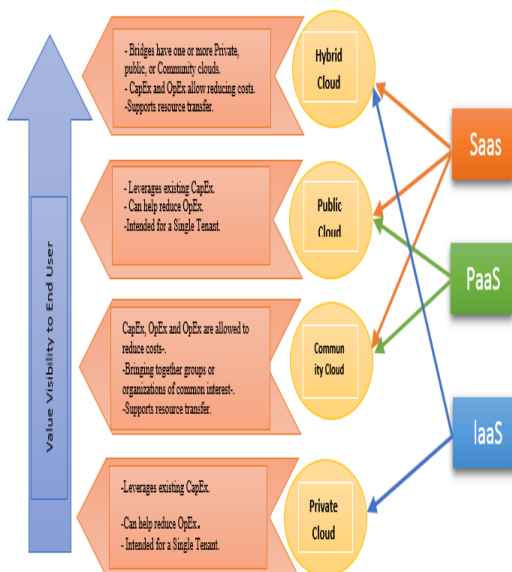**Figure 1.  Cloud Infrastructure as a Service**

- *Platform as a service (PaaS):* is a layer of cloud computing consisting primarily of libraries, intermediate programs, updates, and runtime tools that developers need to update software as a service. Platform technology takes advantage of virtual environments in the "infrastructure as a service" layer to deploy and deliver software developed in the virtual infrastructure as a service. This refers to the provision of facilities to support the whole application development lifecycle, including the design, implementation, debugging, testing, deployment, support and support of rich web applications on the Internet. Web browsers are often used as development environments. Examples of platforms in this category are the Microsoft Azure 6 platform, the Google App Engine7, the Salesforce.com platform for Internet application development 8, and the Bungee Connect 9 platform. SaaS can manage the development of add-ons, as well as web-based application development Independent Internet, re-use of other services and collaborative development in the team.

- *Infrastructure as a service (IaaS).* They provide computer infrastructure. Instead of buying servers, software, data center or network equipment, customers buy these resources as a completely independent service. The service is usually described based on the computing benefit and how many resources are used and therefore cost which will necessarily be reflected at the activity level. Cloud computing uses technology extensively in its "infrastructure as a service" model, as it helps save energy, cost, and space in data centers. Virtual computing is the cornerstone of cloud

architecture. This allows companies to rent these resources instead of spending money on buying dedicated servers and networking equipment. An example of this type of class, amazon1 provides storage S3, EC2 for power computing, and SQS networks for small businesses and individual consumers.

B. *Cloud Computing (CC) Deployment Model (DM)*

Cloud computing (CC) has four different deployment models (DM) [4]. Those modes are models:

- Private Cloud: They are private networks for certain entities that provide full data control, security and data quality. They are private networks for certain entities that provide full data control, security and data quality. The electronic cloud infrastructure works for the specific use of a single organization that includes several consumers such as business units. This cloud may be owned or operated by the organization, another party, or a combination thereof, and may be located inside or outside the organization. Figure 2 shows the models of cloud computing.

- *Public Cloud:* The service provider provides the general cloud applications, storage, and other resources to the public. These services are free or provided on a pay-per-use form. Generally, public cloud service providers such as Amazon, Microsoft, Microsoft and Google own and operate the infrastructure and provide access only via the Internet (direct contact is not provided).



**Figure 2. Models of Cloud Computing**

- *Community Cloud:* The cloud infrastructure is shared by many organizations with similar services and a common interest, such as security, compliance, jurisdiction, etc., whether administered by the institution or by another party. The cost value is distributed to fewer users than the general cloud (but more than the private cloud costs).

- *Hybrid cloud:* The hybrid cloud is composed of two or more drag clouds (private, social or general) whose entities remain unique but committed to each other, and its most important benefits are the submission of multiple publishing models.

C. *Advantages and disadvantages of Cloud Computing (CC):*

Many specialists provide cloud computing with their online services that can be accessed through web browsers. Many of them are offering special offers to provide these services while ensuring their quality through so-called service level agreements (SLAs), which will be an incentive for many individuals and companies to rely on cloud computing. Nevertheless, before you submit your personal data to someone else, some advantages and disadvantages must be taken into consideration:

*1) Advantages*

- Access data from anywhere you can connect to the Internet.
- Security: Most companies use industry-level security programs, making it difficult for hackers to get your data.
- Backups: You have a backup of your data if your device crashes.
- Collaboration: Once you agree, others can access, view, and modify your documents.
- Environmentally friendly: Cloud computing requires fewer resources and thus saves energy! Some companies have taken a step forward and integrated cloud computing with their own telecommuting strategies.

*2) Disadvantages*

- We have mentioned that the security breach becomes more difficult but it is not impossible for hackers to access your data. In the best case, as a compromise with the server where your data is stored, this data will bereave led to the world! It is not only your data that will be affected but also the data of millions of users!
- Power outages: Imagine that you needed a document to make a presentation or an important work meeting and you could not access the storage server location! This happens very often especially at the wrong time!
- Limited storage: While the local hard disk you are using may be able to store data of the size of 005 GB or more, unfortunately, the remote

server may be able to store only 5 GB! If you want to get more space you will have to pay and even after the payment will not reach the storage capacity available in the hard drive.

- Slow speed: Uploading and downloading mega files may take a long time.
- Limited Features: If you use cloud software provided by cloud storage services to process and modify your data, you will lack the features available in the software you use locally.

## 3. LEARNING MANAGEMENT SYSTEMS (LMS)

### A. *Definition and Architecture of LMSs*

It is a system created specifically to help manage, track and evaluate continuous LMSs and all its activities in enterprises through the World Wide Web or the local network. It has more than communication activities and tools to monitor users. To all the, for example, Moodle, A Tutor system [1]. The e-learning management system is characterized by the ability of the educational institution to manage, organize, use and market courses and courses designed in electronic design for schools and universities.

LMSs is *defined* as "integrated software packages that are a system for managing the e-learning process and achieve communication between the parties of the educational system at any time and from any place through the Internet or local network in order to improve the process of learning and learning. LMSs is a system that has been designed and programmed to facilitate administrative tasks, as well as the participation of students in the educational process, coursework in electronic educational materials designed [2]. It is important for LMSs designers to understand the functions of LMSs as follows:

- Record and prepare learners' schedules in online and offline courses.
- Save learner data files.
- Introduce electronic courses.
- Follow the progress of the learner in the course.
- Classroom Management.
- Provide learning administrators with the resources to manage their resources, including laboratories and classrooms (resource management).
- Support the cooperation of learners.
- Use competency data to identify career development paths and performance development.
- Develop and manage exam questions.

- Provide a report on the results of performance examinations.
- Provide certificates.
- Interconnect between virtual classrooms, learning content management systems, and enterprise applications.

Masud et al [12] proposed cloud computing are from the following aspects: cloud computing definitions where the cloud computing platform architecture is characterized by the combination of models, services, business model and LMSs key benefits based on the cloud. One of the most prominent results was a cloud-based solution that could be used to build a virtual environment for both teaching and learning.

Mendez [13] explained that the traditional method of learning on the Internet depends on the building of the system, which exists within universities, which has led to increased many problems, such as large investments however without capital profit for them, resulting in an increasing shortage of sources of development. In contrast, the cloud-based LMSs model is widely used, meaning that the cloud computing system is designed to build LMSs, enabling service providers to receive high benefits.

Pocatilu et al [15] presented the positive impact of using cloud computing architectures upon LMSs solutions development. It focuses on the benefits of cloud computing for e-learning solutions and the LMSs, project management challenges when this architecture is used.

In this paper, a new LMSs paradigm is highlighted by introducing cloud computing on LMSs to increase scalability, flexibility and availability. Figure 3 shows the traditional e-learning networking model, as it advances its issues, and the possibility of transferring LMSs from instructional institutions and universities, within a cloud-computing infrastructure. The model between entity roles and cost-effectiveness can be considered an important advantage. Educational institutions will be responsible for the process of content management, education and delivery, and the seller is concerned with the process of system building, maintenance, development and management [12]. The e-learning system can be expanded, horizontally and vertically alike, and carry the learning organization according to the number of servers used that depend on the number of users.
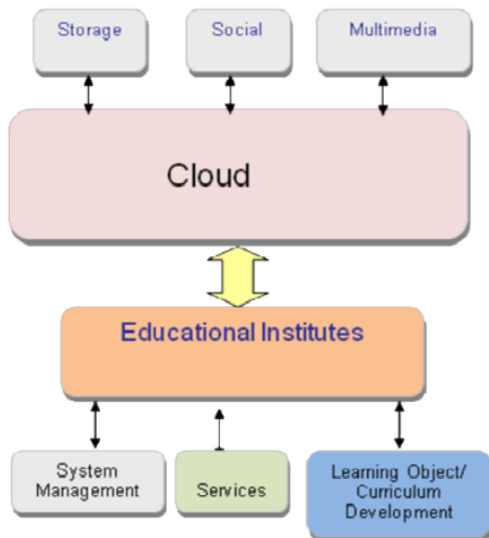
**Figure 3. LMSs Architecture [12].**

*B.   Features LMSs*

The required key features of such systems are [11]:

- *Integration of LMSs with other systems*: When new members, both teachers, and learners, enter the information system, the data synchronizes with other information systems, allowing new members of the institution to be directly added to the LMSs and determine the roles of each member.
- *Creation and design of content education*: includes the creation of content design education, the preservation of confidential data stored, the storage of educational content and may be subject to any additional modifications.
- *Management tools*: Theserequires user account management to run the system through the interface of the system can will be designed easily and simplified so as to enable the management of educational and training courses full access to the system.
- *Access to Learning Content*: LMSs allow access to all members within an integrated learning environment, including teaching methods, language used in content and content users.
- *Assessment and knowledge management*: After the creation and design of the educational content, there are activities such as appointments, tests, and duties that allow assessment and monitoring of the skills and knowledge of the learners concerned.
- *Evaluation tools:* The more evaluation tools are updated, the more positive and valuable feedback will be given to developers about the functionality and effectiveness of the system.
- *Support standards:* In order for LMSs to create and complete the learning content, the requirements must be within international standards such as SCORM which support the standards required for e-learning.

- *Security:* Information security is an important part of any computer system. The data used must be stored in a private database which is password protected and encrypted.
- *Configuration:* The LMSs must allow setting up and customizing the needs of the educational institution.

*C.   Classification of LMSs*

Many of the international companies that have invested in LMSs have developed (and developed) their own solutions. The last decade of the twentieth century saw the emergence of a series of e-learning management systems, including CSS (Closed Source Software) such as Blackboard, WebCT, etc., and OSS: Open Source Software (Moodle, Dokeos, ATutor, Sakai, etc.)

CSS systems are available for an amount of money plus the cost of use calculated according to the number, size, and number of learners involved, while OSS is free and can be modified and developed according to the organization's needs.

In addition, some systems have been developed for specific destinations according to their specific needs, such as the JUSUR system developed by the National Center for e-learning and distance learning in Saudi Arabia in cooperation with the Malaysian Motor company based on the MyLMS ) At the Malaysian Open University.

## 4. CLOUD COMPUTING BASED LMS ARCHITECTURE

Recent studies have shown that users of cloud services are also used in education and training. Studies have also shown that revenue by the end of 2015 using SAS will increase by about $ 22 billion. There is also a trend towards cloud-based learning management systems, with 87% of participants and those interested in this area using the Learning Management System on the Internet, compared to only 13% with the LMS system installed [9].

LMSs howe many benefits where the user achieves the desired goals in a short time. There are many companies that employ opportunities to train and educate staff in a timely manner and place [10]. This would contribute to improving the quality and growth of staff, increasing the competitiveness of organizations, reducing the cost of recruiting new staff, training staff and redirecting them to other sectors of organizations.

The cloud-based cloud service LMSs is a representation of the SAS as a service and integrates the main features of traditional cloud and cloud service functions. A new term - foundation - education program - was introduced as a service, and training on cloud services was described as a new training model [11].

Cloud computing is a model where we can access the network everywhere, and when it comes to common sets of configurable computing

resources (such as the different types of networks, servers, storage, and applications) LMSs can deliver with high speed and launch at the least time and effort. The nature of cloud computing is now characterized by high-value, high value services, and services due to its high-value features.
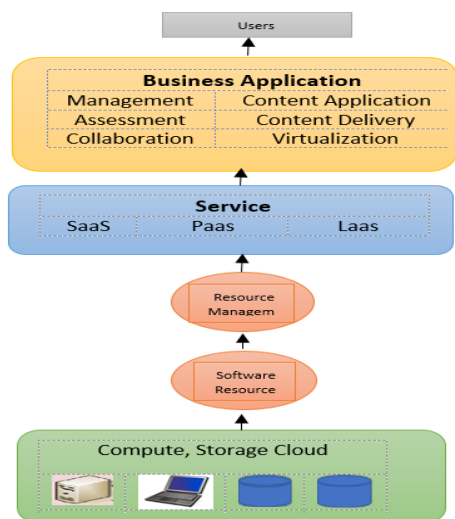


**Figure 4. Architecture of LMSs cloud**

## 5. KEY BENEFITS OF CLOUD BASED LMS ARCHITECTURE

There are many advantages derived from (demand the submit (cloud-based LMSs architecture, as follows:

- *Storage capacity*: A cloud identifies the location of computing and database in a large number of computers distributed across different locations, and provides free clouds in tens of thousands of computers and gives the power of the computer and the space to store large-sized data, providing this cloud as a service available for online user.

- *Low cost:* LMS applications can be run from the cloud through personal computers, mobile phones and tablet PCs that have a minimal configuration with an Internet connection. Where data is created and accessed in the cloud, the user does not have to spend more money for large memory to store data in local machines. Organizations also need to pay per use, so it is cheaper and they need to pay only for the space they need to use.

- *Improved performance*: Because cloud-based LMSs required in the cloud, client-side devices do not create problems and complexity in performance when running and implementing.

- *High protection*: There is a lot of much concern about security and data protection because they are located on remote servers that are likely to be corrupted or disappear without any warnings. In the cloud computing model, data is stored and maintained extensively and relies on one or more data center, unified data management managers, software deployment, security monitoring, thus ensuring data security and protection of users to the maximum extent possible.

- *Virtualization simulation*: It is the most important attribute of this type of architecture. Manage, execute, relay, and backup through a virtualization platform. It puts key computers, including servers, storage, network equipment, and virtualization, to build a shared resource pool, customized and instructions.

- *Enhance document formatting:* There are some files and documents that do not open correctly on some computers. LMSs applications that work with cloud computing open various documents through LMSs applications based on the cloud opening the file from the cloud.

- *Benefits for students:* Students get more advantages and demeanor through cloud-based LMSs. Students can take courses online, solve assignments, attend online exams, get course results and tests, and submit their research projects through the Internet.

- *Benefits for Teachers*: Teachers who use LMSs electronic cloud have many benefits. Teachers ever able to prepare online tests for students and create better content management for students through content management, assessment of tests, student duty, research projects distributed to students, feedback and communication with students through online forums.

- *Instant software updates:* The cloud-based LMSs application operates on the strength of the cloud, where the software is automatically updated from the source of the cloud. Therefore, learners are constantly receiving email the latest updates instan eously.

- *Interactive model of cloud architecture proposed LMSs:* In this classic LMSs model, it shows the tasks of teachers in training students using interactive skills through these programs. The program also prepares students through the Internet and through virtual

learning (interactive sessions) between teachers and students, where the teacher answers different students' questions. In addition, teachers can also use multimedia to promote educational content. Students are encouraged to collaborate and interact with each other to complete graduation projects or group through learning and collaborative work among students. The interactive pattern of the proposed architecture is detailed in. figure. 5.
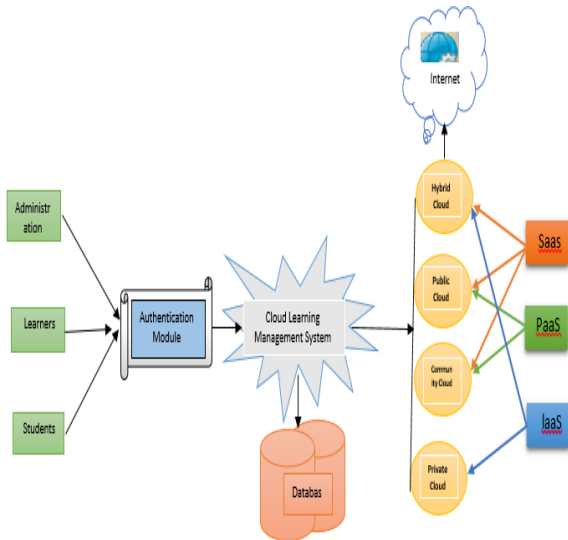


**Figure 5. Interactive model of the proposed architecture**

## 6. DISCUSSION AND CONCLUSION

Cloud computing provides a great opportunity for educational institutions to improve their LMSs, providing secure and user-protected systems. Cloud computing also helps all users to provide full knowledge to teachers and learners through cloud-based services and applications from any device containing this application. This has helped all countries around the world to use the cloud. The most important benefits of the cloud are reducing the cost and simplify the provision of educational services. Also cloud computing enables students at different levels around the world to acquire modern and advanced skills, and provide them with the most needed information to compete and succeed in the global knowledge and information society. The economic situation and the current technological development will force different educational institutions and organizations to reconsider the adoption of the electronic cloud solution. Universities and educational institutions have begun to commit themselves to this initiative and there is evidence of increase the benefits of the cloud and a significant reduction in expenditures due to the implementation of electronic cloud solutions.

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