

Enhancing Security of Cloud based LMS by deploying secure Loopback Protocol

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Abstract

Education is rapidly expanding these days, and each of its fundamental processes and approaches is evolving at a rapid pace. The global education system is moving toward a cloud-based learning architecture. When the socioeconomic situation is terrible, such as during a global epidemic, educational institutions have little choice but to employ cloud-based learning. Cloud-based learning methods are becoming increasingly dependent on the future of the global education system because to its flexibility, diversity, user friendliness, economics, and structure. In this Covid-19 pandemic condition, study from home is the new trend in education culture. Of course, it is a precautionary measure to avoid disease infection. Because schools and universities are closed during the pandemic, education sectors, rely heavily on "online study." This urgent requirement to gradually update security inside a cloud infrastructure has been highlighted by the fast rising cloud-centric focuses among organizations and institutions. While malicious software that can infiltrate cloud computing infrastructure is a big cause of concern, the possibility of unauthorized software deployments under an infrastructure-as-a-service model can expose a cloud service provider to a myriad of legal and regulatory issues. In this paper, it is considered and attempted to construct a secure loopback connection framework, which prevents access to any other web site once a secure connection to the primary interface for monitoring and tracking software deployments has been created.

Keywords LMS, Cloud Computing, SSL, Virtual Reality, Dynamic Learning, Loopback Protocol, Billboard Manager.

1 Introduction

Nowadays, the worldwide educational sector, whether it is schools, colleges, or any educational service provider, uses LMS to give competitive service to their end users, allowing them to gather and refresh their knowledge at any time and from any location. Having said that, all service providers face significant security difficulties as a result of several remote customers accessing the same platform via cloud-based network access. Here comes the role of VPN (Virtual Private Network), which increases the power of a private network so that it can function as an internet among public networks [1, 2]. In the current Information Technology era, advanced cloud computing is generating a virtual area or classroom for both students and educational institutions. The LMS, which uses cloud computing technology, provides ample capacity for numerous subjects to be taught to multiple users, simplifying the modern educational process. Now that being in the Internet technology era and using cloud computing services, it is evident that one must be employing specific software on a web platform [3, 4]. The authors of this paper will attempt to examine the issues of adopting web-based or virtual secured LMS on cloud computing in the present era with the help of Loopback Protocol.

The Research work is having following sections, Section 2 Presents a brief knowledge of technological challenges LMS. Section 3 Described Related works till date by extensively going through related articles and researches. Section 4 said about the proposed works and Methodology with optimum explanations in details. Section 5 briefly described Result Analyses. Lastly, the Conclusion and Way Forward described in Section 6.

2 Technological Challenges of Cloud Based LMS

The notion of cloud computing received crucial governmental validation when the first US Chief Information Officer advocated the establishment of a cloud computing strategy for the US Government [5] in September 2009. As a result, the National Institute of Standards and Technology (or NIST) was tasked with migrating to cloud computing technology. However, formulating cloud computing standards and explaining the underlying concepts, as well as precisely defining security and privacy features in technical terms, were the most important focal areas that would control all cloud computing technologies from that point forward [5]. This is what drives improved system optimization, cost reduction, higher dependability, and stable operation.

2.1 Cloud Computing Services

The cloud system, also known as cloud technology, is a unique technical approach that allows learners to participate in virtual learning or e learning sessions from any location at any time via an internet connection [6]. Together, clouds computing and e-learning establish a virtual arena for teachers and students or learners to share their ideas [7]. In today's world, the educational system has been entirely transformed into a digital paradigm, with cloud-based learning management systems playing a significant role. Different types of cloud computing are developing at a breakneck pace around the world.

Public: The public cloud is the most prevalent sort of cloud computing, and as its name implies, the public cloud is open to all users. This form of cloud service is made available to the public across a network, with data being entered and kept on service providers' servers.

Private: A private cloud is controlled by a single company. The organisation maintains devices in the company's local data centre, which is handled by an internal staff in this approach.

Hybrid: The advantages of a public, private, and community cloud are combined in a hybrid cloud. It has all of the advantages of all forms of cloud computing deployments[8].

The cloud system is maintained or built using three levels of service structure/parameters. These are A. SaaS (Software as a Service) B. Platform as a Service (PaaS) and C. Infrastructure as a Service (IaaS).

The following figure 1 is showing different level of services provided by cloud computing service provider.

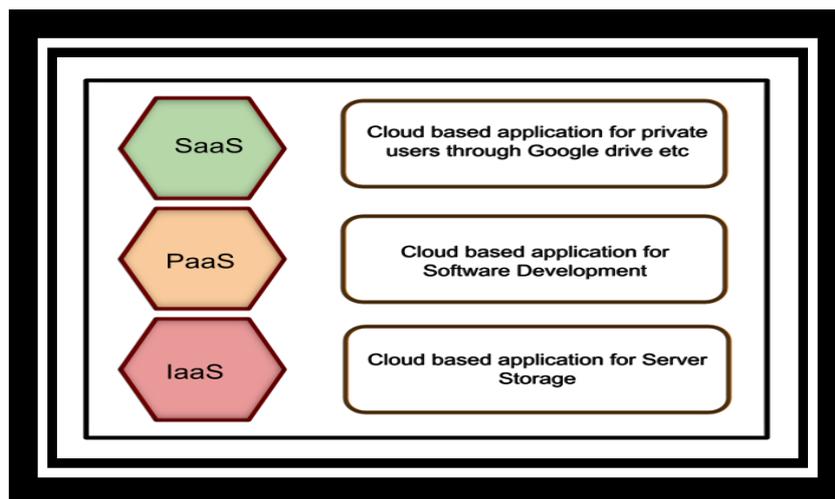


Fig. 1. different level of services[8]

2.2 LMS

LMS stands for learning management system, and it is software that assists in the seamless operation of an e-learning platform. The students use the internet as a medium to learn at their own pace. It provides a platform for professors or guides to assess students by administering online exams and analysing their results [9]. LMS is mostly on on ever-evolving information technologies. Users or learners encounter a number of technological concerns, including security, suitable equipment, infrastructure, affordability, quality, and accuracy [10]. As a result, the user's technological acquisition is the challenge. The following image 2 depicts the universal acquisition of e-learning approaches and their mediums [11].

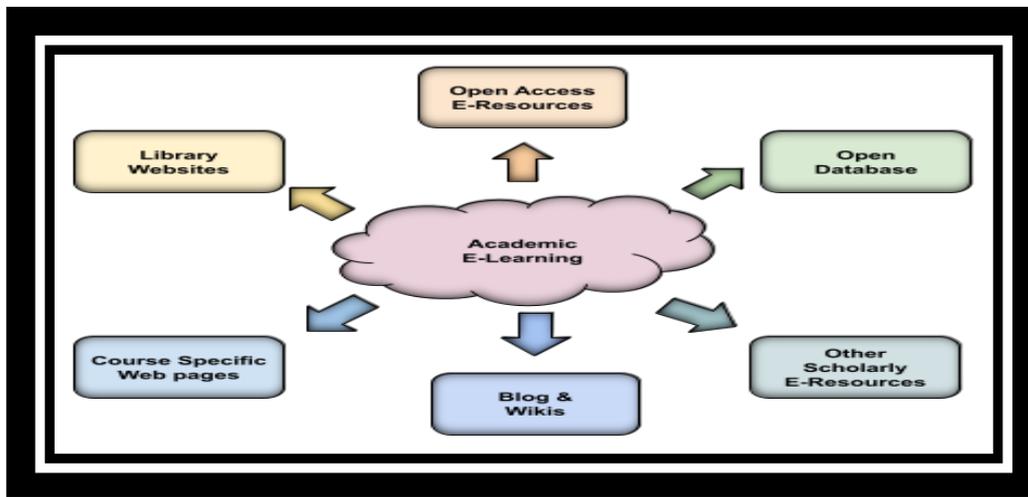


Fig. 2. learning methods and its mediums

Open Source vs. Cloud LMS

The two most common types of LMS are Open Source LMS and Cloud LMS. Choosing the best LMS might be difficult at times. Users always select the LMS service they require based on price, features, and categories. Table 1 compares and contrasts two learning management systems.

| Open Source | Cloud Based |
|---|---|
| Having an open source code that users can access for free | Managed by specific service provider with SaaS. |
| Customized for specific requirement | Users can get specific user id and password |
| Open to use model | Pay per user model |
| Cost effective for basic using, need to pay for additional features | specific periodical cost involve |
| It needs higher knowledge of coding and IT expertise | Plug n play model, user friendly |
| Lack of dedicated service provider | dedicated service provider |
| Example: Moodle | Example: Google Classroom |

Table 1. Comparisons between open source and Cloud based LMSs

Benefits

When educational institutes and companies struggle to cope with the e-learning model due to technical knowledge, expense, and maintenance, LMS provides a service provider to assist them by delivering the following services [12], as shown in table 2.

- Effective cost
- Minimum infrastructure
- Maintenances and update the software
- Safe platform
- Creating both way communication environment between teacher and student
- Evaluation facilities
- Date storage support
- On time and any time access facilities

Table 2. Benefits of using Cloud based LMSs

2.3 Security Aspect

To avoid contamination during a pandemic, students and professors are continuing their studies from their own, geographically separate locations. Through cloud computing, they are all connected to a shared platform. This entire cloud-based technology allows users to access a vast and diverse database over the internet. Now that users are constantly dealing with large amounts of data, a data storage centre and its associated management system are unavoidable [13]. Storage device, software, hardware interfaces, and communication network make up the complete infrastructure. There are three sorts of participants in this cloud service paradigm. Service providers, programmers, and end users are the three groups. Service providers are in charge of maintaining and monitoring the service, as well as the infrastructural components. Programmers are in charge of delivering infrastructure-based services to end consumers. End customers use the full range of cloud service features over the internet to do personal and corporate duties from a variety of locations [14]. Now that several users are using the same platform in a cloud

service, there is a major issue about security. Because the cloud computing system is dependent on some technicalities, there are many security level protocols, such as SaaS, PaaS, and IaaS, that efficiently manage the security system. Table 3 shows the many sorts of hazards associated with cloud-based LMS.

| Threats and other issues associated with Cloud Based LMS [15] | | | | |
|---|----------------|----------------|------------------------|----------------|
| Data Privacy | Internet | Application | Personal Devices | CCE |
| ✓ Malfunctioning | ✓ Availability | ✓ Technology | ✓ Infected old devices | ✓ Data Storage |
| ✓ Loss | ✓ Traffic | Infrastructure | ✓ Malware | ✓ IT |
| ✓ Copying | ✓ Service | ✓ Service | ✓ Hacking | Infrastructure |
| ✓ Quality | | | | ✓ Cost |
| ✓ Availability | | | | |

Table 3. Different types of threats relating cloud based LMS.

SSL VPN is the current trend, rather than classic VPN IP security, to provide more advanced security and execution on the network. Data protection and LMS application tunneling, on the other hand, are the smarter processes than data backup and network tunneling. The presence of a Service Level Agreement (SLA) is critical for maintaining stable internet latency. SSL VPN is considerably superior to other VPN technologies in terms of benefits. This provides a low-risk platform for remote users to connect to a private network via the SSL protocol, which is the successor to Transport Layer Security. SSL VPN provides a user-friendly interface in addition to security. The ultimate goal of SSL VPN is to provide service providers with a safe and reliable cloud connection so that end users can have secure, quick, and user-friendly access as well. The deployment and use of software licences that were purchased with on-premise deployment in mind is one of the primary hurdles for clients wishing to shift to the cloud from on-premise deployments [16]. This is especially important given that when it comes to cloud computing security and service level agreement issues, compliance is a major focus area [8]. Physical resources, data storage and retrieval facilities, virtual network infrastructure, and virtual operating systems are all part of a cloud service provider's IaaS duty. While this type of service model allows customers to install their own software and application tools, software licensing issues usually occur.

3 Related Work

After reviewing a number of studies and reports on the subject, it was discovered that there are ongoing research and studies to improve the usability of cloud-based LMS while maintaining optimum security. Some articles and studies' points of view are listed below:

A paper [1] addressed the nontechnical issues that instructors and students experience while using a cloud-based LMS. The goal of this study [2] was to identify the primary myCourseVille interface flaws using a usability evaluation approach that included five usability characteristics on the student and teacher interfaces, as well as LMS software recommendations. User satisfaction levels were investigated in the research [3], as well as the necessity of using a cloud-based LMS in pandemic conditions and what parameters should be employed to improve user pleasure. The behavioural purpose of LMS in a COVID environment is stated and studied in paper [4]. It provides a moderated examination of e-learning acceptance among Corona Virus-affected students. The focus of the study [9] was on cloud computing and its virtual platform technology, as well as its benefits and problems. Research [10] examined the evolution of LMS in terms of its use as a product or as a service, as well as how it aids the educational system. This research [11] examined the suggested cloud computing architecture based on LMSs for creating a virtual e-learning environment. The author of [12] seeks to come up with a recommended e-learning architecture that would help to correct the shortcomings in the present cloud-based learning system. As the number of learners grows in the next years, the top five e-learning technologies covered in this article are expected to gain in popularity. With each passing day, the number of e-learners grows, and there are a limited number of tools available, each with its own set of pros and downsides, with some platforms being unnecessarily complex. Key characteristics of cloud computing, as well as its security and privacy, were discussed in [14]. The influence of the Covid-19 epidemic on Cloud Computing is explained in the study [15]. A cloud service provider can match any software licences installed by a customer within the allocated IaaS cloud region, according to paper [23]. The architecture is built around a secure loopback connection framework that prevents access to any other web site after establishing a secure connection to the principal interface for monitoring and tracking software deployments.

Various articles have represented the technical implementation and adaptability of digital learning in the twenty-first century, spanning educational establishments, students, and teachers. Various articles discuss the LMS paradigm, including course content, distribution, tracking, and technology augmentation. In this study, a few relevant publications are examined in order to continue the research.

4 Proposed work and Methodology

The purpose of this proposed project is to provide a cloud-based software licence agent monitoring and management system that is safe and web-based. In IaaS or PaaS modes, the proposed LMS architecture places software licences on virtual machines. The fundamental design integrates components from the Billboard Manager paradigm [17], [18] as the major licence collation and tracking system delivered in a cloud environment. The Billboard Manager and users logging into the SSL-augmented Software License Management System (SASLMS) [19] can establish a secure and dedicated link. Once an SSL connection has been established, the Billboard Manager will automatically configure the user's browser proxy to point at localhost with the IP address set to 127:0:0:1:3128. When this mode is activated, users will be able to access the software licencing administration web portal. Then, valid and authorised users can begin software licencing auditing and view the findings [20], [21]. This loopback approach's security has been demonstrated. According to experiments, once a person is hired by the Billboard Manager, they only have access to the secure gateway via which a link is established [32]. The suggested LMS Architecture Module is depicted in Figure 3, and the algorithms are depicted in Figures 4, 5.

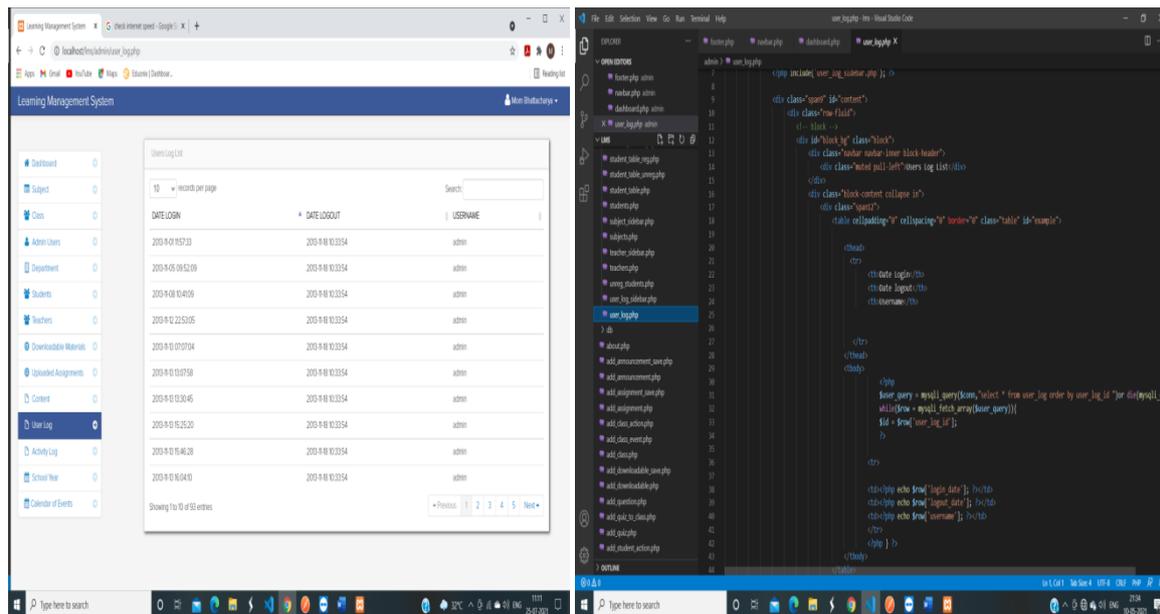


Fig. 3. Proposed LMS Architecture Module (ADMIN LOG ACTIVITIES)

- Step1: Start**
- Step 2: Initiate Billboard Manager**
- Step 3: Check for Connected VMS within Cloud LMS Architecture by BILLBOARD Manager**
- Step 4: Check for VM Hardware, Install Agent to detect Software and Keys**
- Step 5: Collect, Collate data, Push to Storage**
- Step 6: Pull Existing Data**
- Step 7: Match and set alert for changed in configuration in any VM**
- Step 8: Accept, Input for user Authentication**
- Step 9: Use browser Host secured by 127.0.0.1 over HTTPS**
- Step 10: Checking Browser Security and User credential**
- Step 11: Input User request for Report**
- Step12: Stop**

Fig. 4. Algorithm for Secured loopback connection framework

Step 1: Installing the proposed SSL box

Step 2: Creating a Signed Certificate

Step 3: Installing licenses on the box

Step 4: Creating A virtual LMS Server

Step 5: Creating Local Users and Groups

Step 6: Configuring a Name LMS Server for the box

Step 7: Configuring Name Resolution

Step 8: Browser Plug-In

Step 9: Assembling of Both Access Gateway Appliances in HA(High Availability) Mode

Fig. 5. Algorithm for Secured Remote Access of Cloud Based LMS (With Citrix Access Gateway Box)

5 Result

Students and teachers each have their own logins. Students must initially register in the system before moving on to the next phase. Users who have not registered will not be able to use any of the system's features. After logging in, students can view/download course materials and assignments, submit assignments, give comments, and interact with other students and teachers. Teachers can upload course materials and assignments for students, see or download submitted assignments, assess or mark them, and leave comments after logging into their own profile. Finally, users must logout of the system after finishing their obligations in their different accounts for security reasons. In the proposed approach, the Billboard Manager is utilised to find all underlying virtual machines built by a cloud service provider to provide IaaS and PaaS services [22]. The first component of our proposed paradigm is a software licencing detection tool that analyses individual virtual machines. This helps the primary Billboard Manager Engine inventory and update indexed databases that detail the hardware specs and licences used in each virtual machine. The second component of our proposal is the Billboard Manager engine, which is a multi-factor gateway that provides SSL services. In a database made up of tables, the Billboard Manager also maintains track of user accounts, biometric data, virtual machine information, software licensed data, and history.

6 Conclusion and Way Forward

In this situation where online education is only way to continue with total education system as Covid -19 pandemic is still existing in whole World, it is utmost important to have proper security measures to have safe log in and accessing the online medium. For that the optimum protocol is to be amended. To keep in mind the security part, author has tried to give few recommendations as loopback protocol to have safe access to internet and have online education.

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