Private cloud based e-learning infrastructure for Sri Lankan higher education

K.P.N. Jayasena[a,b] and G.K.S.W. de Chickera[c]

School of Computer Science and Technology, Wuhan University of Technology Wuhan, Hubei, P.R.China; Department of Computing and Information System, Sabaragamuwa University of Sri Lanka; Sri Lanka Institute of Advanced Technological Education; pubudu.nuwanthika@gmail.com

Abstract

Cloud computing technology is an emerging internet based computing for delivering computing services that are delivered as a service over a network. The e-Learning solution is one of the technologies which implement the cloud power in its existing systems to enhance the functionalities providing to students. Cloud technology has various advantages over the existing traditional e-Learning systems. Providing e-learning services using a cloud-based platform can reduce costs, can be easier to maintain and update, and offer benefits to end users in terms of security and compatibility.

Most existing e-Learning platforms in Sri Lanka are unable to share learning resources between cloud platform and public network, and normally need additional cost to deploy the environment. In this paper, we study how cloud computing can benefit e-learning education in Sri Lanka. We explore the cloud computing educational environment and discuss how universities get advantage from cloud computing not only for cost but also in terms of efficiency, security and reliability. And finally we present a new e-Learning infrastructure based on the private cloud and virtual private network. The proposed e-Learning infrastructure help students to easily setup and configure own e-Learning environment with less cost for efficiently sharing resources in universities. The research objective of this project is to build an e-Learning infrastructure for Sri Lankan education system which will enhance the learning progression. We propose a new architecture that deploys a private cloud model which allows better utilization of the IT infrastructure for educational purposes. The second research objective includes providing a cost effective solution, scalable, and accessible environment that could be deployed in any learning institution. It offers the flexibility to meet rapidly changing software requirements for current and future requirements for teachers and students. Another objective is to provide an own storage space in the cloud to the students. Then students can use the cloud storage space to store their daily experiments. The important objective is to provide flexible environment for different platforms to access the e-Learning system. It must also provide for other network domains to connect to private cloud network. It supports multiple client platforms both inside and outside the university infrastructure. This Proposed framework solves the various challenges faced by e-Learning, and increases the availability, reliability and scalability of cloud based e-Learning systems.

Introduction

Sri Lanka is facing many challenges when introducing new e-learning concepts to increase the opportunities for learners to continue with lifelong learning. Education in Sri Lanka has a long history which dates back two millennia. Sri Lanka has a digital divide in the education sector. To overcome the challenges the government and higher education institutes have taken steps to initiate course delivery via e-learning. The higher education institutions in Sri Lanka have already started embracing e-learning to for main stream course delivery. However, there are many developments requirements such as infrastructure, training, resources and skilled personal to complete a successful delivery.

Cloud computing technology is an emerging internet based computing for delivering computing services that are delivered as a service over a network (typically the Internet).With the rapid growth of cloud computing, the cloud has provided the variety of application in education. Most existing e-Learning platforms are rarely shared between the public or private cloud platform and private infrastructure network, and normally need additional cost to deploy the environment. This research presents a new e-Learning framework based on the virtual private network and private cloud, which could help the student to easily setup and configure own e-Learning environment with less cost for efficiently sharing resources in Sri Lankan universities. It could solve the various challenges faced by e-Learning, and increases the availability, reliability and scalability of cloud based e-Learning systems.

In this research, I propose to build a framework to utilize the Cloud's features in the teaching process of several courses. Since there are several of cloud types and services, we identify the courses that could apply Cloud Computing to their teaching processes. The main contribution of this research is to building private cloud using open source software and combined it with e-learning system. Private cloud provides university a secure platform to run e-learning services; so many industries are planning to implement private cloud. The private cloud implemented in a cluster based environment using open source technologies. The e-Learning system mainly consist of three steps, virtual machines implementation for computer science courses, backup system implementation and role based authentication system develop for user account management. These features let for an efficient work with virtual machines.

Virtual private cloud concepts are formed by dynamically configurable pools of cloud resources connected to university private network with VPNs. This framework of VPN and private cloud integration provides the users with shared resource in the university environment. The e-Learning platform is also scalable and capable to interconnect with other multi-platform developed in different locations.

Background

E-learning

E-learning is a hot topic in education field and has been growing fast since the first web based courses in the mid to late 1990s. E-learning comprises all forms of electronically supported learning and teaching. A 2013 ECAR study of e-learning discovered that nearly all institutions (98%) have at least departments, units, or programs with a major interest in e-learning. Based on the literature review, some of the benefits of e-learning are, it allows students to access material when needed and study at their own preferred place, low delivery cost, learners are required to critically engage with the lot of information available, shared learning by allowing interaction among learners from diverse backgrounds and freedom of speech.

Sri Lankan University System has 15 national universities in Sri Lanka including the Open University of Sri Lanka. Although technology has progressed greatly in recent times, universities in Sri Lanka still use traditional face-to-face teaching for the transfer of course content. The research carried out by the Faculty of Information Technology, University of Moratuwa showed that e-learning is the most appropriate learning method when compared with face-to-face learning, problem based learning (PBL), project work and discussion groups.

There is an emergent trend regarding the research of e-learning or virtual e-learning platform.There are several education institutes some examples are the Khan Academy Virtual Learning Center of Granada University, the Open University of Catalonia, the MIT Open Course Ware, and 'free online courses' of Standford University virtual courses, which are clearly supported by the e-learning approach. EdX is a joint partnership between the Massachusetts Institute of Technology (MIT) and Harvard University offer online learning to millions of people around the world. EdX will offer Harvard and MIT classes online for free. Harvard Extension School offers many courses for credit over the Internet. The Internet is used to deliver course lectures with video, audio, and multimedia. Live lectures are recorded and made available on demand through "streaming video" technology. Students use additional technologies to work on exams and homework assignments and to communicate with the instructor and other students in the class.

Cloud Computing based E-learning

Many Universities are moving to cloud based e-learning system in an efficient way. Cloud based e-learning system combines with the power of Big Data to offer a powerful and smart system.. E-learning systems can benefit from using cloud computing.

It allows researchers search and find models and make discoveries fast. Universities can open their technology infrastructures to private and public sectors to advance research. 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 be connected to campus services for education. Faculty members are seeking efficient access and flexibility when integrating technology into their classes. Researchers want instant access to high performance computing services.Table 1 makes a comparison of different cloud based e-Learning system

Methodology

In this section describes the overall architecture of the e-Learning Infrastructure for Sri Lankan higher education with the cloud platform. Before implement the e-Learning infrastructure first we outline the goals and requirements. When the course is made in the e-

Learning infrastructure it should be available more globally and extend educational reach.

Table1. Comparison of different system which were proposed

Existing Systems	**Special Functions**	**Functions/Drawbacks**
A Novel Approach for Adopting Cloud[1]	Presents a framework that specifies a number of steps for academic institutes as well as organizations to adopt cloud computing	Fails to provide dynamism in E-Learning
A Sharable E-Learning Platform Computing[14]	Introduces Cloud computing into an e-Learning platform to allow the integration of different e-Learning standards to enhance interoperability of learning objects.	It only concentrates in providing sharing reusability and inter-operability and fails to incorporate other required features of an E-Learning System
Research on E-learning system based on SOA[15]	E-learning system based on SOA can support real time mutual in teaching and integration varies resources of computer teaching,	This architecture does not provide a client interface and provides connection only through a network service interface.
New framework Semantic Web Technologies based E-learning[16]	Method of extracting useful information on the web and also provides superficial knowledge about semantic web	It presents a study on how to extract useful information on the web and it is platform dependent.
A Generic Architecture for Agent based E-Learning System[17]	The architecture considers interactivity, personalization, adaptation, interoperability, collaboration, security to enhance the quality of learning process.	Does not provide Authentication facilities. Since it is not hosted in cloud, it does not provide any of the cloud features.
An E-learning Ecosystem Based on Cloud Computing Infrastructure[2]	Cloud computing realizes an e-learning ecosystem with an infrastructure which is reliable, flexible, cost-efficient, self-regulated, and QoS-guaranteed	It does not contain security features and backup system.
BlueSky Cloud Framework[18]	Physical machines are virtualized and allocated on demand to e-Learning systems It also consists of three layers, the virtual infrastructure, capability and data caching layer. It improves availability, performance and scalability of e- Learning systems.	It is a conceptual framework and no descriptions about the validation methods
Virtual Computing Laboratory[19]	Virtual Computing Laboratory (VCL) is an open source implementation of a secure production-level on demand ,utility computing and services oriented technology	The task is given to the supplier who hosts hardware, software and data, that can affect security and price may be unpredictable.

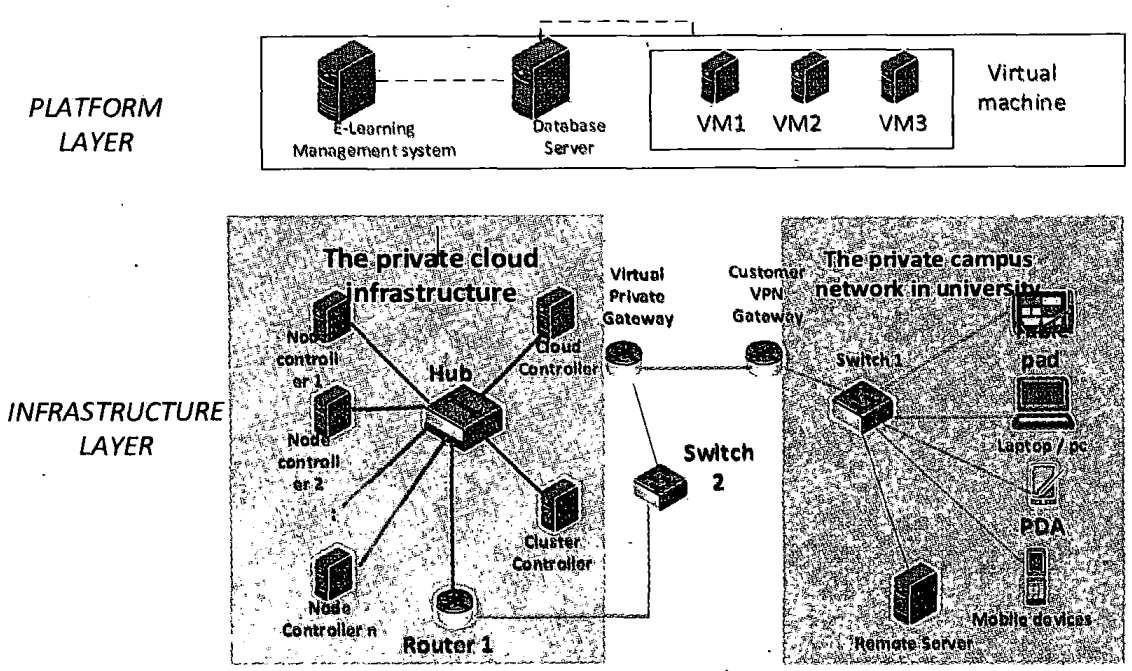

Fig. 2 The overall e-Learning architecture

Users must have the possibility of accessing educational resources in the university domain through cloud infrastructure. Students and teachers should connect to the infrastructure from anywhere (e.g. at home, at work during a coffee break), without the need of anything other than an average computer and an internet connection. The university infrastructure implement in a different network domain and our cloud framework deploy in another network domain but these two networks must have a flexible and secure communication path. It will provide a flexible, efficient infrastructure for the students and could let the students easily setup, access and use the resource by private cloud.

Fig. 1 illustrates the overall architecture of the system. The basic architecture of consists of A front end which runs one or more Cloud Controller (CLC), Cluster Controller (CC) ,Walrus (WS3), Storage Controller (SC) and One or more nodes. A CLC manages the whole cloud and includes multiple CC's. A WS3 attached to a CLC.A CC can contain multiple NC's and SC's. Ultimately the VM's will be running in the NC making use of its physical resource.

This section illustrates how to integrate e-learning functionality with private cloud system. This approach has been chosen because it enables better usage of existing e-Learning infrastructure and the model can be expanded into a hybrid or public cloud.

The purpose of implementing the private cloud is to distribute different stakeholders to run virtualized infrastructure, environment and service.

This platform for managing virtual infrastructure will automate, coordinate and integrate the existing solutions for networking, storage, virtualization, monitoring and management of users. In this approach, students and staff are provided with tools easily access to the essential educational and scientific services and resources. The implemented architecture allows for a better agility of IT systems at the university system, since it is possible to move a virtual machine to another physical node without any downtime of service. It solves many of the current problems in the management of server environments, and enhances the performance of the operating system and applications.

VPN based private cloud e-learning system

A system which attempts to meet the requirements of an enterprise ready cloud computing environment using virtual private clouds is being developed. The system forces existing virtualization technologies at the server, router, and network levels to create dynamic resource pools that can be connected to enterprises.

The following diagrams show the proposed network,

Implementation of virtual e-learning system

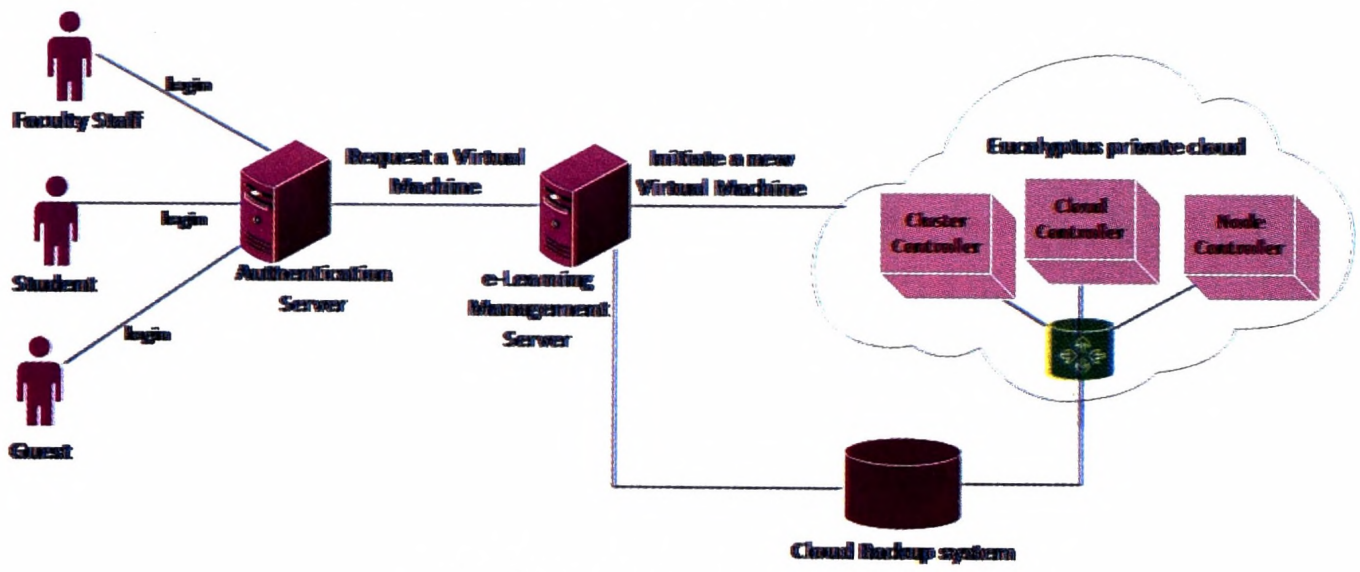

Fig. 3 Virtual e-Learning system

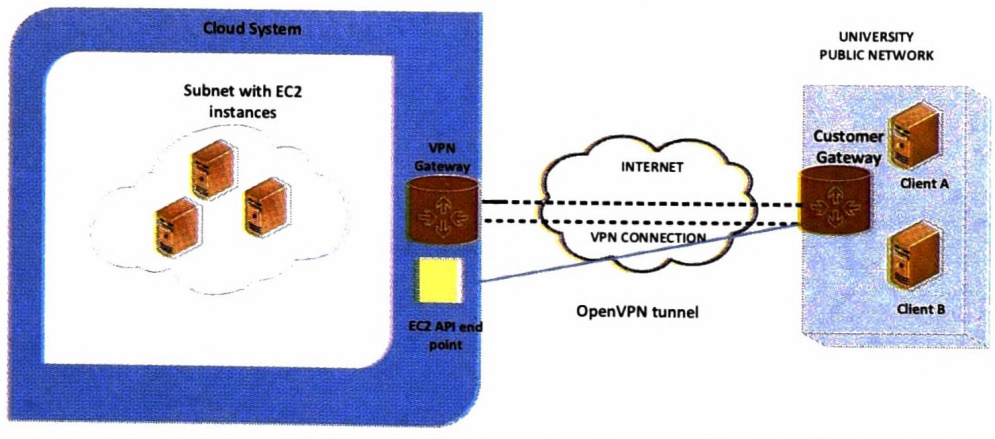

Fig. 4 . Implementation of VPN based private cloud e-learning system

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