Assessing Experimental Private Cloud Using Web of System Performance Model

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ABSTRACT

Cloud computing has attracted the attention of educational and research institutions as a way to support modern trends in teaching and learning. This article describes the performance assessment of a private cloud within a university environment using the Web of System Performance (WOSP) model. A survey was carried out to measure the respondents’ attitude towards the use of private cloud in which students and experts serve as sample. Testing was conducted by designing a virtual lab consisting of a number of virtual machines operated by a selected sample. The results showed that the usage of cloud computing in university has good perceived system performance judging from how it fares in the constituent parts of the WOSP model. Furthermore, the study revealed that usability and flexibility outperformed criterion like security. Moreover, several non-functional criteria outperformed functionality. In short, the knowledge and results presented from assessing a private cloud using WOSP model could be beneficial for users, designers and managers of private clouds especially in universities.

KEYWORDS

Cloud Computing, Educational Technology, OpenStack, WOSP Model

INTRODUCTION

The rapid development in Information and Communication Technology (ICT) and the ever-changing educational needs, along with the significant growth in the volume of data and information exchange, have created several challenges in managing university’s network. Accommodating these challenges using the conventional forms of IT services may pose a strong barrier on the way of modern educational process (Tønnesland, 2013). This is mainly due to the high cost involved in providing and maintaining the needed hardware and software that may be unaffordable to the university (Rao & Challa, 2013). This is true since most countries in the world experience a decline in higher education budgets. However, universities should continue to deliver high quality of educational services regardless of the limited budget. Therefore, cloud computing has gained much momentum and has become popular in managing universities' digital resources.

There are several different definitions of cloud computing found in the literature. The de-facto definition of cloud computing by The National Institute of Standards and Technology (NIST) is as follows (Mall & Grance, 2011):

DOI: 10.4018/IJGHPC.2017040102

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Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

Cloud computing has been universally recognized as a critical component in educational and research institutions. It provides access to applications, services and computer resources from any place inside or outside campus using the Internet (Aniyikaiye & Udoh, 2016). Cloud computing delivers flexible, on-demand, and scalable computing services including servers, storage, databases, networking and software via the Internet. Based on the cloud size, ownership and access pattern, cloud computing deployment models can be classified into four common models namely public, private, community, or hybrid clouds. In addition, cloud computing offers three different types of services called Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). Private cloud deployment model and IaaS service model are the point of focus in this study.

Cloud computing offers a great opportunity and benefit for universities where advanced tools are necessary for data sharing, teaching and learning, as well as for research activities. Cloud computing is the environment that enables students, staff, faculties, administrators, and other campus users to use applications on the Internet such as leaning management system, university portal, mail services, library applications and many other e-services (Sachdev & Mahajan, 2013). Many universities have started implementing their own private clouds to achieve the highest returns of their technology investments, to protect and manage their information effectively and efficiently and, at the same time to reduce cost through improved machine utilization, reduced administration time and infrastructure costs.

This article evaluates an experimental private cloud built in an educational environment. To the best of our knowledge, many works have been reported in the literature on performance evaluation of private cloud using Technology Acceptance Model (TAM) (Habbal et al., 2017) (Udoh, 2012) or other forms of quantitative or qualitative analysis (Sloan, 2013). The main aim of these works is on the assessment of the perceived ease of use and perceived usefulness – in other words, the usability and functionality of the private cloud respectively. However, other important factors were not considered such as privacy, security and some other non-functional criteria.

This article describes our study on eight performance criteria identified in the WOSP model which are used to assess a private cloud in an educational setting. Specifically, this article makes the following contributions:

1. The design and implementation of a simple but realistic private cloud within a university research laboratory environment using open source platform OpenStack (Icehouse) Release. The article introduces OpenStack, its main components, and a brief description of the configuration steps. The implemented private cloud is designed to deliver IaaS services and tested according to the OpenStack recommended settings to confirm its smooth running and correct configuration.

2. The assessment and performance evaluation methodology for implementation of private cloud using the WOSP model. This work follows a new approach for evaluating cloud computing where eight criteria namely security, extendibility, flexibility, reliability, functionality, usability, connectivity, and privacy were considered in the experiments. The analysis gives insights on private cloud performance and paves the way for further research in this area.

The following section presents the background and related works on OpenStack and the WOSP model; while the article concludes with a discussion section on what the obtained results present as well as suggestions and recommendations for future works.
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