

Chapter 10

Free and Open Source Cloud Computing Technology

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ABSTRACT

This chapter covers the free and open source cloud computing technology and its application in Web-based IT education. It discusses the difficulties in teaching online IT courses. One of the technologies that can be used to overcome these difficulties is cloud computing. This chapter focuses on cloud based online teaching infrastructure created with free and open source cloud computing. It provides some strategies in developing various cloud based computer labs for hands-on practice required by IT courses. A case study is used to illustrate the use of the free and open source cloud technology in e-learning.

INTRODUCTION

Today, it is necessary for many organizations to develop and manage Internet based IT infrastructure. Through such IT infrastructure, an organization's employees across the world are able to access the software provided by the organization. Based on their needs, the organization's contractors are able to implement their own virtual IT infrastructure by using the resources provided by the organization. Internet based IT infrastructure can also provide a collaboration platform for developers to participate in an IT project anywhere and anytime.

Cloud computing is the technology that is designed to support such online IT infrastructure. The cloud computing technology provides three types of the services, Software as a Service (SaaS),

Infrastructure as a Service (IaaS), and Platform as a Service (PaaS) (CloudTweaks, 2010). These cloud services are designed to meet an organization's computing requirements.

- **Software as a Service (SaaS):** Instead of installing software on each local computer, this cloud service allows an organization to provide the software which is accessible through the Internet. The users with proper authentication are able to remotely access the software through the Internet. With SaaS, an organization may also subscribe software provided by other organizations.
- **Infrastructure as a Service (IaaS):** Instead of constructing IT infrastructure on physical networks, servers, and database

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storage devices, this cloud service provides virtualized servers, networks, data storage, and other necessary devices. The customers of an organization can subscribe these virtualized networks, machines, and devices to construct their own IT infrastructures which are accessible through the Internet. Again, an organization can subscribe IaaS provided by other organizations. When subscribing the IaaS service from other organizations, the organization can significantly save the cost of constructing its own physical IT infrastructure.

- **Platform as a Service (PaaS):** When a team of developers working together on an application project, it is ideal for these developers to work collaboratively on the same IT infrastructure and in the same location. However, the developers may have to work at different locations across the world. In such a case, PaaS provides an organization with a Web-based application development platform. With PaaS, the development team can work collaboratively on designing, developing, testing, deploying, upgrading, and hosting Web-based applications. Like SaaS and IaaS, the organization can subscribe PaaS from another organization.

When an organization provides cloud services for its own use, such a cloud is called a private cloud. The private cloud is built on top of the organization's existing IT infrastructure. The organization's IT department develops and manages the cloud services. The subscribers of the cloud services must be authenticated by the organization. All the data on the private cloud can be stored in a private data center located in the organization's network.

On the other hand, when an organization provides cloud services for the public to subscribe, this type of cloud is called a public cloud (Velte, Velte, & Elsenpeter, 2009).

BACKGROUND

Subscribers of a public cloud pay for the usage of cloud services. Therefore, the public cloud subscribers do not have to develop their own physical IT infrastructure to support their own computing needs. The public cloud subscribers may not have total control of where to store their data. It is possible that several public cloud subscribers share the same storage device. Sometimes, the data may be stored somewhere far away from the local region. This nature of the public cloud may cause some concern of data security. On other hand, public cloud providers are often the enormous IT organizations such as VMware, Amazon, IBM, and Microsoft. The IT infrastructure built to support the public cloud is robust enough to handle large and intense computing tasks. It provides backup and restoration mechanisms so that the computing resources are highly dependable and highly available on the public cloud.

Although cloud computing provides a flexible and efficient computation platform, it can present a great challenge for small or non-profit organizations if they develop and maintain their own cloud based IT infrastructure. The private cloud requires the organization to create a physical IT infrastructure to host the cloud services. Highly skilled IT service technicians are needed to develop and manage the private cloud. In addition to the cost of highly skilled IT technicians, many small organizations or non-profit organizations are not able to cover the cost of hardware and software to support the private cloud. On the other hand, the charges for the public cloud services may also be too high for many small organizations and non-profit organizations. For example, the cost for some of the public cloud SaaS, IaaS, and PaaS packages are:

- **Microsoft Office 365:** Microsoft Office 365 is typical of SaaS. For an organization of 25 users, the annual subscription fee of Microsoft Office 365 is \$150/user

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