A Review of Virtualisation and Cloud Computing for Higher Education

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INTRODUCTION

Virtualisation in the classroom provides students with the impression that they are interacting with applications, services, and files which are stored locally, when in fact the applications, services, and files may be stored on a server off site, or at an alternative location on site. "Virtualization is a technology that permits the abstraction of the software from one computer and its easy deployment in another one, which may house additional virtualized machines" (Martín, Marrero, Urbano, Barra, & Moreiro, 2011, p. 349). Server virtualisation is when an Information Technology manager or computer administrator partitions a server to create several instances of virtual servers, thereby multiplying the working capacity of the physical server.

"Network virtualization serves as an effective method for providing a flexible and highly adaptable shared substrate network to satisfy the diversity of demands" (Gang, Hongfang, Lemin, Anand, & Hao, 2011, p. 381). The objective in using network virtualisation is to save on the cost of power and resources by centralising administration and improving the utilisation of hardware and software resources. Therefore, enabling students to consume applications and services as required, while unaware of the fact that the operating system and applications which they are using are stored, operated, and running remotely. Students can access a standardised desktop interface from any thin client on campus to access their work, eliminating the need to work from a specific laboratory or desktop.

This article reviews how cloud computing can be achieved in higher education by leveraging the use of technologies such as virtual machines and thin clients. The background section provides a brief overview of how virtualisation and cloud computing are achieved.

The next section provides a discussion of some of the advantages and disadvantages of virtualisation. Issues, controversies and problems associated with the implementation of virtualised systems are then reviewed. Followed by: solutions and recommendations; future research directions; conclusion; references and additional readings.

BACKGROUND

The background section provides the reader with some information on the following: virtualisation and cloud computing; and the use of virtualisation for higher education, to assist the readers understanding of how virtualisation can be realised.

Virtualisation and Cloud Computing

This section explains how Terminal Services and Thin Clients are used to realise virtualisation.

Figure 1. shows how Terminal services can provide the same operating system to many work stations in the same laboratory. Alternatively, terminal services can provide each individual user with the operating system they specifically require, be it an Apple, Windows or Linux environment. Terminal Services are hosted by a terminal server to provide multiple client sessions simultaneously in an attempt to reduce the cost of providing information technology services. Terminal Services (TS) refers to software installed on a server which provides a view into the image which will be displayed on the thin clients for student use. "Server applications are required to operate continuously and remain highly responsive to frequent client requests" (Liu, Wang, Li, & Gaudiot, 2011, p. 452).

Figure 1. Virtualisation: Terminal services
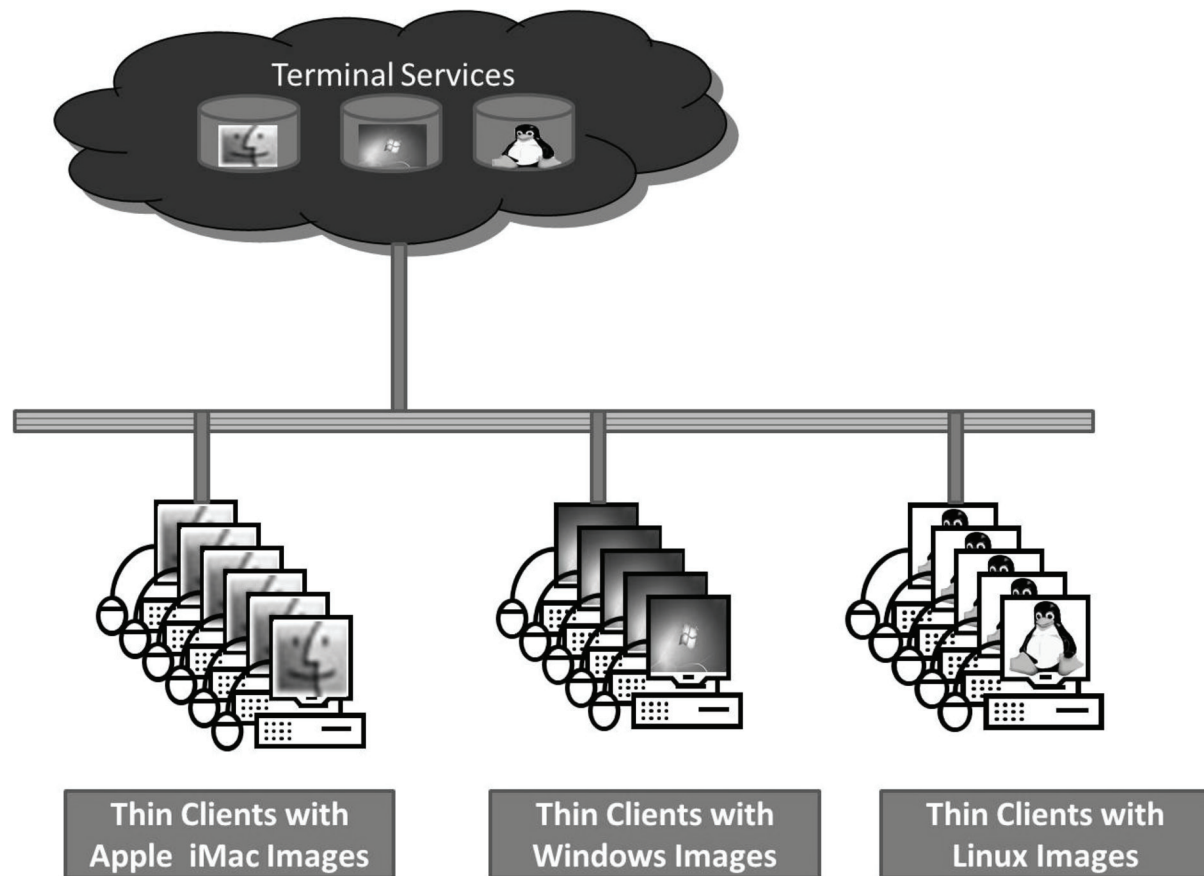
A thin client does not contain the same central processing unit, hard drive, random access memory and data stores as a desktop personal computer, instead thin clients rely on host servers to provide the computing resources users require via the web. Due to reduced functionality thin clients are cheaper to purchase than desktops. The use of thin clients for student use enables the partitioning of servers to create virtual machines which appear to the user as powerful computer devices. "The central server in a thin client network is often called the 'terminal server'. It is a powerful, high specification machine, capable of handling a large number of logged-in clients" (NCTE, 2008, p. 19).

Figure 2. shows how operating systems, applications and storage spaces contained on centrally stored servers can be accessed by mobile phones, thin clients, desktops, laptops and tablets. Cloud computing implies the delivery of computing services over a network (Internet or Intranet), to provide Information Technology as a service (ITaaS).

Virtualisation for Higher Education

Increasingly educational providers are expanding the use of technology to enhance the profile and quality of the courses on offer through the use of electronic course profiles (ECPs) (Wadley, 2010). Recent negative changes in the finances of world economies are having an adverse effect on the budgets available to higher education (Powell, Gilleland, & Pearson, 2012). Therefore, managers in higher education are endeavouring to maintain IT services at reduced cost. The achievement of virtualised computing through the use of thin clients is one approach which may prove attainable in achieving this aim. "Higher education certainly serves both the market and democracy" (Suspitsyna, 2012, p. 67) and society in general, hence, there is a requirement to at least maintain the quality of services provided and if at all possible continuously improve the IT services offered.

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