Virtualization as the Enabling Technology of Cloud Computing

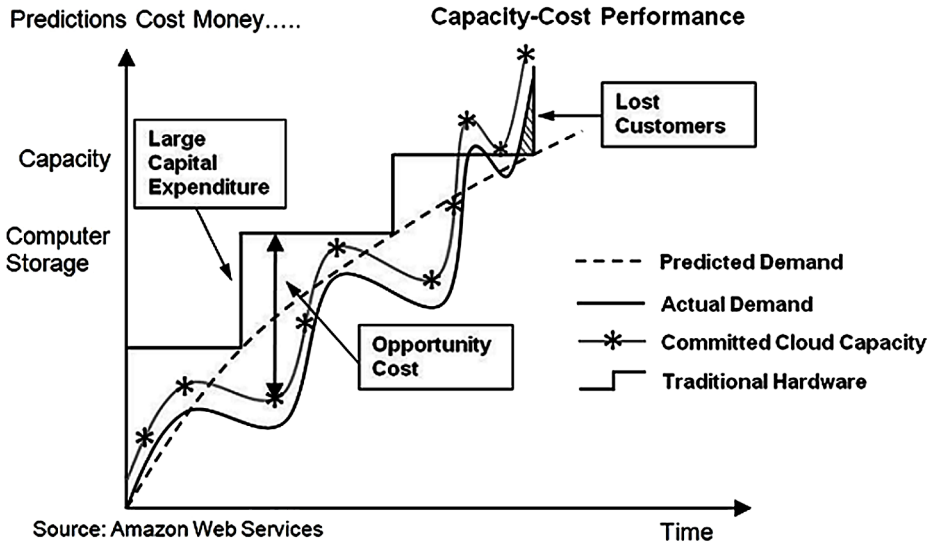
Mohamed Fazil Mohamed Firdhous
University of Moratuwa, Sri Lanka

INTRODUCTION

Cloud computing has become the newest computing paradigm that has made a long time dream of making computing a utility a reality (Buyya, Yeo, Venugopal, Broberg, & Brandic, 2009). The initial attempt at providing computing as a utility was attempted by IBM through renting its mainframe computing resources to the Wall Street using remotely connected dumb terminals. Then the idea just died down until it again became popular in the early 2000s as cloud computing. Cloud computing makes it possible to purchase and use computing resources similar to utilities such as electricity, water, gas and telephony. The utility model allows the customers to consume any amount of resources and pay for only the resources that have actually been used. Prior to the arrival cloud computing, computer systems were generally purchased outright. The systems thus purchased had fixed capacity irrespective of the actual demand. Figure 1 shows the capacity-utilization curve developed by Amazon Web Services depicting the usage of disk storage under cloud computing and traditional computing models (AWS, 2012).

From Figure 1, it can be seen that the traditional computing model shown by the step wise resource allocation is unable to follow the demand pattern. On the other hand, the cloud based resource provisioning closely follows the demand pattern in both short term as well as long term fluctuations. Thus cloud computing provides the right solution for any venture irrespective of their nature of business. On cloud computing, the committed computing resources and the money spent would have a very close and strong relationship with that

Figure 1. Capacity-utilization curve
Source: AWS, 2012



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of the real demand. This would make the money spent on these resources fully worth. Also cloud computing effectively transforms the money spent on the computing resources into an operational expenditure rather than a capital expenditure that has traditionally been. This helps businesses to utilize their capital fully on core business activities (Jaatmaa, 2010).

BACKGROUND

The technology that works behind to make cloud computing possible is hardware virtualization (Siddhisena, Warusawithana, & Mendis, 2011). In cloud computing, a single system is partitioned and hosted in parallel. These parallel systems can be spawned on demand and allocated to different users (Siddhisena et al., 2011). Once a user has completed his work, the virtual system can be removed and all the resources are released so that they can be allocated to another user in the future.

The virtualized computing infrastructure is created by installing a Virtual Machine Manager (VMM) on the physical hardware (Li, Yang, Kandula, & Zhang, 2010). The VMM provides the necessary isolation and security between the multiple virtual machines running in parallel on a single physical computer. Hosting individual fully functional systems on virtual machines maximizes the utilization of the physical systems as the physical system can be allocated to many customers. When many virtual machines are hosted on a single system simultaneously, its performance may start to degrade after a point due to the competition for resources between the hosted systems. So, in order to maintain the service quality, the maximum number of virtual machines hosted on a system must be limited.

Advantages and Disadvantages of Virtualization

Virtualization of computer hardware results in many benefits along with certain shortcomings. Though there are a few disadvantages, the advantages for sure outweigh those disadvantages. Ameen and Hamo (2013) have carried out an extensive analysis on the advantages and disadvantages of hardware virtualization.

The most prominent advantages and disadvantages of hardware virtualization are listed below:

- Ability to have better server and application consolidation
- Improve security through sandboxing
- Multiple simultaneous execution environments
- Better use of existing hardware
- Reduction in IT infrastructure costs
- Reduced downtime or increased uptime and faster failure recovery
- Simplified system administration
- Ability to have gradual capacity expansion
- Support for legacy systems and applications
- Simplified system installation and deployment
- Better system and application testing business continuity and disaster recovery capabilities
- Improved business agility
- Better resource sharing and utilization
- Increased flexibility, availability and scalability
- Enhanced security, isolation and hardware independence
- Better load balancing
- Opportunity for single points of failure
- Reduced performance, if not managed properly
- Complicated management interface
- Increased networking complexity and debugging time

HISTORY OF VIRTUALIZATION TECHNOLOGY

The initial work on creating virtualized systems started way back in the early 1960s by organiza-