



A New Cloud Infrastructure Approach For Higher Education Institutions

Authors

Nouhad Amaneddine

Faculty of Computer Studies
Information Technology and Computing Department
Arab Open University-Lebanon

namaneddine@aou.edu.lb

Beirut, 2058 4518, Lebanon

Abstract

Information Technology (IT) is playing a vital role in the modern educational system especially in higher education sectors. Higher education institutions are challenged to adopt latest IT resources due to the increasing competitive pressures from the competitors leading to offer new services required by these institutions. The implementation of physical networking infrastructure with advanced equipments in computer laboratories is difficult to achieve using the accessible resources in most of the higher education institutions. One of the distributed computing solutions "Service Oriented Architecture (SOA)" technologies creates possibilities for the purpose of establishing new learning methodologies and will reach to a more deep rooted education. The emergence of cloud and virtual computing has grown globally and solved the problem of the limited resources by reducing direct expenses of IT. In this paper, we evaluate the possibility of enhancing students' performance, particularly, students working on their graduation projects by using cloud infrastructure implementation. In addition, this paper proposes a new approach to provide a solution for virtual labs using a Private Cloud. This will include various features and services of a Typical Cloud environment without any change to the existing basic services in the institution and will add flexibility to include any services in the network without having any extra effort of Network Management.

Key Words

Virtualization, Cloud, Cloud Computing, Distributed Computing, IaaS

I. INTRODUCTION

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appropriate name on the style menu. The style will adjust your fonts and line spacing. Do not change the font sizes or line spacing to squeeze more text into a limited number of pages. Use italics for emphasis; do not underline.

Adoption of cloud computing is definitely accelerating and much of this is being driven by requirements for organizations to be more adaptable and flexible in responding to IT needs [1],[5]. Cloud computing is fundamentally dependent on the network to connect the Cloud service provider with the consumer [2]. Researches reveal that most of the vendors have changed their direction to support this concept and most of the large companies have implemented it or planning to implement it in the coming future [3], [14]. Cloud computing is a model enabling convenient, on-demand network access to shared pool of configurable computing resources for example networks, services, storage, applications and services, that can be rapidly provisioned and released with minimal management effort or service provider interaction [4].

Cloud computing is seen as a highly available computing environment where secure services and data are delivered on-demand to authenticated devices and users utilizing a shared, elastic infrastructure that concurrently supports multiple tenants [6],[7]. The adoption of public cloud computing will become more beneficial as it can quickly add more capabilities to the existing IT systems in the education institutions without investing in new expensive infrastructure, buying or deploying new application systems. This research focuses on a problem faced by the final year IT students and staff using the network implementation and also the integrations of various web based application on Cloud system [15]. Students studying IT specializations have to come up with a working prototype of a system in implementation of a real time project for their final semesters. Most of the students are expected to implement and test their final prototype in a virtual environment. Students need to share common resources such as PCs and Networking devices for their prototype. It includes sharing of time, storage space and the infrastructure. This can reach to a threat to their important data which they have saved for their final implementations. Also it leads to loss of time and their efforts for the same. It is difficult for the institution to provide a complete infrastructure for which utilization is nominal and expenses are too high. Other than the cost of physical setup there is lot of operational and maintenance cost involved in such setup [16].

II. SERVICES OF CLOUDS

The traditional installed software on the campus computers are now replaced by cloud computing with an aim of reducing the expenditure of the higher education institutions. By using cloud infrastructure, higher education institutions can gain significant flexibility and can migrate sensitive data into remote cloud data storage. To use the cloud services the higher education institutions has to define their requirements and has to take a considerations for security, privacy, confidentiality issues. There are several cloud services available [8], [9], [10].

Infrastructure as a Service (IaaS): can be used to satisfy the infrastructure needs of the students, academic and administrative staff remotely or locally with some specific hardware configuration for a specific task.

Platform as a Service (PaaS): certain providers are opening up application platforms to permit users, especially IT staff, to build their own application without the cost and complexity of buying and managing the underlying hardware and software layers.

Software as a Service (SaaS): the application service provider is hosting the application which runs and interacts through web browser, hosted desktop or remote client. It eliminates the need to install and run the application on students' and staff own computer and simplifying maintenance and support.

Computing as a Service (CaaS): providers offer access to raw computing power on virtual server such as Amazons, EC2 service

Figure I depicts the general use of various cloud services used in higher education institutions by academicians, administrative staff, students, IT staff and developers.

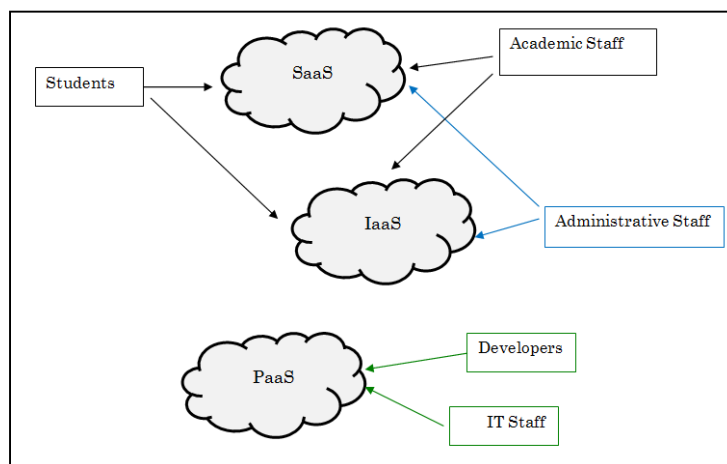


FIGURE I: USE OF CLOUD SERVICED IN HIGHER EDUCATION INSTITUTIONS

III. COSTS IN CLOUD IMPLEMENTATION

There are two types of costs involved in cloud implementation, Direct and Indirect costs.

Direct costs: Network management and hardware management tools, annual maintenance contracts, facility costs (space, power, and cooling requirements), and implementation (deployment and provisioning) costs

Indirect costs: Availability costs, such as planned downtime, unplanned downtime, loss of employee productivity, and revenue loss due to network downtime

The following are computing resources required implementing e-Learning methodology for a typical higher education institution and the costs to implement those resources need to be considered.

- Learning Management System (LMS): This is the main system used to deliver course content and facilitate interaction between students and instructors and between students and course content. Multimedia software also can be incorporated in LMS to develop course materials by integrating animations, video, and audio into course content in order to make courses more interactive.
- Student laboratories: Higher education institutions that run eLearning programs have computer laboratories or public access labs to provide Internet access blended learning students.
- Digital libraries: They are used to access journals, books, and other learning resources.
- ICT infrastructure: ICT infrastructure consists of a computer server and a computer backup server with associated accessories

Table I shows the direct and indirect costs required for the network infrastructure implementation

TABLE I: DIRECT AND INDIRECT COSTS

Direct Costs	Indirect Costs
• Asset Utilization • Hardware Costs • Power Efficiency • Enabling Redundancy • Security • Supply Chain Management • Personnel	• User (Staff/ Student) logs on to a cloud portal and verifies/updates credentials and information. • Based on the user entitlement, a selected a set of services are identified and presented for definition.

IV. ABOUT CLOUD IMPLEMENTATION

The existing solutions for the enterprise data center do not work for virtualized data centers. The leading cost in the enterprise is operational staff and in the data center, such costs are so small due to less automation. In virtualized data centers, automation is a mandatory requirement of scale, and thus the cost will be higher [11].

There are various vendors available providing cloud services such as Amazon, Microsoft etc. Depending on the requirements of the organization one can choose for a specific type of setup

[12], [13]. In this study a private cloud model is chosen in the higher education institution's campus. There are mainly two reasons for choosing this method. One of them is the high bandwidth requirements for the students' required services and the second one is being an academic organization the security and safety of the information placed on the cloud to be ensured. Running large scale, high availability infrastructure requires the efforts of many talented staff members and the dedicated attention of upper level management.

V. PROPOSED PRIVATE CLOUD (IAAS) INFRASTRUCTURE

Cloud Computing is considered in the second place after business intelligent on the list of the top five most influential technologies [14]. Within this work we have initially targeted the adoption challenges of implementing a Private Cloud. This led us to leverage the work by into the management of IT outsourcing projects using a life cycle.

Higher education institutions have already adopted an e-Learning system infrastructure that is able to support all the functions based on the requirement of the institution. Figure II depicts the existing e-learning system infrastructure which supports synchronous and asynchronous communications.

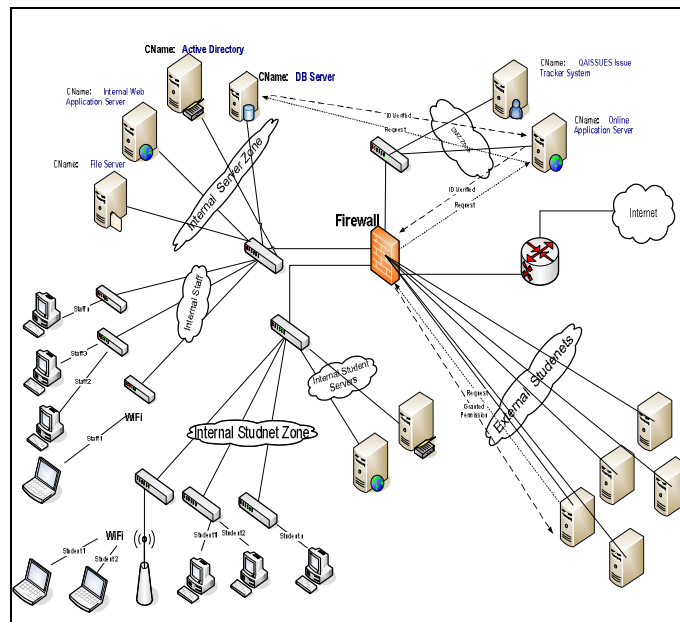


FIGURE II: THE EXISTING E-LEARNING NETWORK INFRASTRUCTURE

Figure III depicts the proposed setup of private cloud infrastructure in a higher education institution, which provides the IAAS cloud service, a Virtual Laboratory infrastructure for students of the institution. The proposed Private cloud infrastructure model is consists of three main servers for virtualization. One server is used for management and another one for storage. The connection between the storage server and Virtualization server is done through fiber optic

cables. In demand to meet the requirements, we have provided private cloud architecture for virtual lab on-demand services and a fully web-based solution, which enables the users to easily utilize virtual and real computing resources via an intuitive and user-friendly interface. In case if the number of users increases or more Virtual Machines (VMs) are required, physical resources can be added into the setup. The students can immediately and easily access cloud environment for storage, networking, and computing. Storage Server holds the images of the VMs which in turn results in restoring the VM quickly and it can be automated in case of disaster.

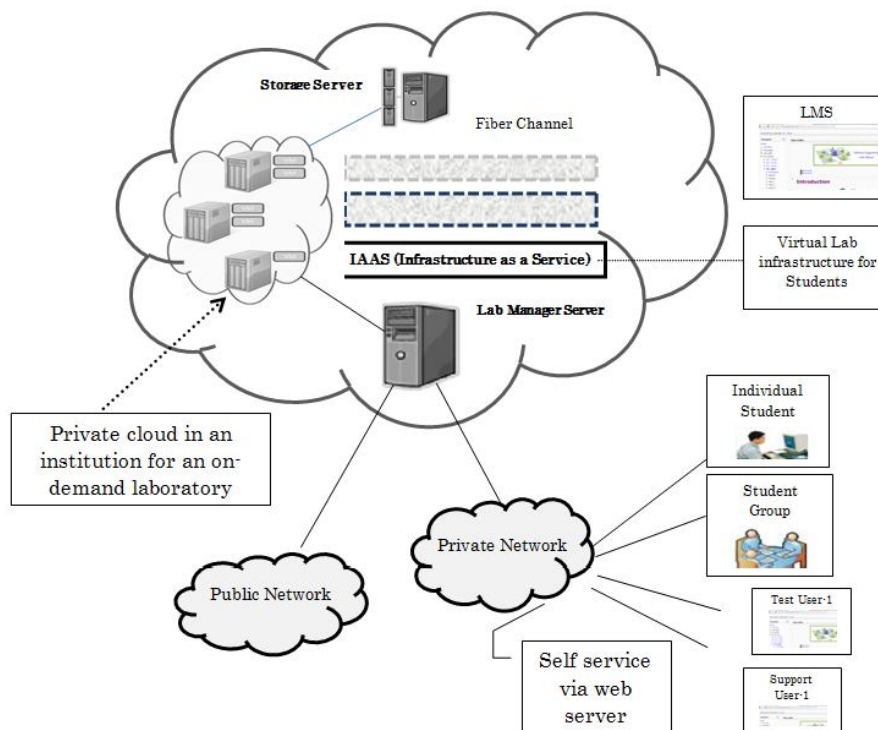


FIGURE III: PROPOSED PRIVATE CLOUD (IAAS) INFRASTRUCTURE

The advantage is that it decreases network delays and the time required for data transmission which, in short, increases the competence of task completing and data contact. One potential drawback to this operation is that the data is usually erased once the virtual machine (VM) is deleted. To address this issue, a task is added which agrees to the user to operate remote storage space such as Dropbox and iFolder to save the data. In this way, the system is capable of offering space with full data security and stability. The data can be stored permanently even if the VM is deleted.

VI. CONCLUSION

In this paper the we have specified the requirements for implementing a dynamic cloud computing infrastructure in a higher education institution. The final year IT students will be able to use IaaS services remotely and locally to complete their graduation projects. This

proposed infrastructure comprises a pool of physical computing resources such as processors, memory, network bandwidth and storage, potentially distributed physically across server. These resources can be organized on demand into a dynamic logical entity called a “cloud”. These resources can increase or decrease in real-time in order to assure the desired levels of performance, scalability, reliability and security to any application that runs in it.

In this research some key areas of deficiency with current virtualization and management technologies are identified. We have sketched the importance of separating physical resource management from virtual resource management. A reference architecture model is proposed for a distributed cloud computing management platform which will form the basis for enabling next generation cloud computing infrastructure. Study has shown how this infrastructure will help and provide benefits to the stakeholders and particularly the final year students.

REFERENCES

- [1] Avery, P. (2009). “Research indicates increase in cloud computing”, IT Business Edge, August 26, available at: www.itbusinessedge.com/cm/community/kn/blog/research-indicates-increase-in-cloud-computing/?cs¼35256
- [2] A Complete History of Cloud Computing .(2012, January). Retrieved October 5, 2013, from SalesForce: <http://www.salesforce.com/uk/socialsuccess/cloud-computing/the-complete-history-of-cloud-computing.jsp>
- [3] Bret, M. (2009). “In Clouds Shall We Trust?” IEEE Security & Privacy, Vol. 7, Issue 5.
- [4] Mell, P., Grance, T. (2011). The NIST definition of cloud computing. Gaithersburg, MD: National Institution of Standards and Technology (NIST).
- [5] Cisco Cloud Computing - Data Center Strategy, architecture, and Solutions, Cisco Systems, (2009).
- [6] Saju M., (2012). Implementation of Cloud Computing in Education – A Revolution, International Journal of Computer Theory and Engineering, Vol. 4, No. 3, June 2012
- [7] Katzan Jr., H. (2010). “On the Privacy of Cloud Computing,” International Journal of Management and Information Systems, Vol. 14, No. 2, pp. 247-255.
- [8] Kazmi, SI, Pandey,J., Hayat MS, Nagarale, A. (2014), “Using private Cloud to Elastically Extend Site Resources”, Proceeding of the International Conference on Applied Information and Communication Technology (ICACIT-14), pp. 743-748.
- [9] Girish L S , Dr. H S Guruprasad , (2014). Building Private Cloud using OpenStack, International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Volume 3, Issue 3, May – June 2014, ISSN 2278-6856.
- [10]Microsoft, (2013). Microsoft Private Cloud:Evaluation Guide. Microsoft.
- [11]Singh, B., 1 October 2011. Cloud Deployment Models – Private, Community, Public, Hybrid with Examples. Techno-Pulse. Available at:

<http://www.techno-pulse.com/2011/10/cloud-deployment-private-public-example.html> [Accessed May 2016].

- [12] Sudip C., (2010). An Enterprise Private Cloud Architecture and Implementation roadmap, IT@Intel White Paper. Intel.
- [13] The Economics of the AWS Cloud vs. Owned IT Infrastructure, 2009. Amazon web services.
- [14] Anurag S., (2013). Cloud Computing and Its Vision 2015, International Journal of Computer and Communication Engineering, Vol. 2, No. 4.
- [15] Raj K., (2015). Research on Cloud Computing Security Threats using Data Transmission, International Journal of Advanced Research in Computer Science and Software Engineering Volume 5, Issue 1, January 2015 ISSN: 2277 128X
- [16] Philipp L., (2016). Patterns in the Chaos - A Study of Performance Variation and Predictability in Public IaaS Clouds. ACM Transaction on Internet Technology, Vol. 16, Issue 3, June 2016.
- [17] Nelson, D. L., & Cox, M. M. (2005). *Principles of biochemistry* (4th ed.). New York: Freeman.
- [18] Ferres, K. (2001). *Idiot box: Television, urban myths and ethical scenarios*. In I. Craven (Ed.), Australian cinema in the 1990s (pp. 175-188). London, England: Frank Cass.
- [19] Senden, T. J., Moock, K. H., Gerald, J. F., Burch, W. M., Bowitt, R. J., Ling, C. D., et al. (1997). The physical and chemical nature of techniques. *Journal of Nuclear Medicine*, 38(10), 1327-33.
- [20] Shobhadevi, Y. J., & Bidarakoppa, G. S. (1994). *Possession phenomena: As a coping behavior*. In G. Davidson (Ed.), Applying psychology: Lessons from Asia-Oceania (pp. 83-95). Carlton, Vic., Australia: Australian Psychological Society.
- [21] Rose, S. L. (2006). *Essays on almost common value auctions* (Doctoral dissertation, Ohio State University). Retrieved from <http://www.ohiolink.edu/etd>
- [22] Smith, B. *An approach to graphs of linear forms* (Unpublished work style), unpublished.
- [23] Wang, J. Fundamentals Methods to map organizations' strategy, Journal of Management, submitted for publication.
- [24] Nicole, R. Technology acceptance review, *Journal of Information management*, in press.
- [25] Saunders. (1997). Dorland's illustrated medical dictionary. (28th ed.). Philadelphia.