Meta-Modeling Cloud Computing Architecture in Distance Learning

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Abstract

Cloud Computing Architecture in distance learning has grown exponentially in the recent past. Distance Learning itself has been accommodated as an innovative technology in the IT infrastructure. It has had numerous inventions that have always offered substantial merits and benefits to major activities that human beings undertake. Due to increased demand for educational computing, usage of digital devices like Computer Based Tutorials, mobile devices and web technologies, learning administrators and practitioners in many academic setting are able to access and deliver education services electronically. Consequently this has been made easier with the availability of cloud computing as a technology. This technology has to be adopted and put to effective use by these institutions so as to reap the benefits of cloud computing in relation to distance learning. Distance learning is a vital source of dissemination of knowledge and therefore this paper explores and presents the opportunities, insights derived from cloud computing architecture in Distance learning. We also examine how the learners, administrators, practitioners and institutions will benefit from cloud computing services in disseminating knowledge and indispensable skills. Throughout the assessment, there is a clear illustration of cloud Computing framework ,Cloud based Architecture, how a Software can be used as a service, how a platform can be used as a service and how Distance learning can be of great benefit to the society if the opportunities provided by cloud computing can be adopted and implemented. This includes passing across the relevant educational materials, sharing and warehousing of these materials and data and increasing quick access by deploying cloud computing as an IT infrastructure.

Keywords: *Cloud Computing, Distance Learning, Architecture, IT infrastructure.*

1. Introduction

[1] assesses education as compulsory and the ratio of gross enrollment in higher education is not at par with the world economic growth. Distance learning is one of the growing potential methods of education. For institutions to provide information technology that supports research and development cloud computing models have to be mingled to accommodate mobile devices, service models and development models. Cloud computing presents itself as an on- demand computing with which users are allowed to have access to data, applications and services

anywhere. This is distinguished using private and public clouds [3] which can present services inside and outside the organization. To accelerate the access of educational computing to each and every corner of this world, the use of performance tools, which allows users to use applications without installation of personal files is promoted [4]. While the traditional client- servers models relied on dispatching requests and response, the cloud computing model represents high powerful computing, dynamic virtualized resource. Mobility paradigms plays a vital role in trying to access educational computing, the Information and Communication technologies provides an infrastructure that acts as a paradigm [3] in defining services anywhere and anytime. SaaS provides a realistic approach in using different services. Distance learning is the modest and effective way of realizing that goal. Distance learning, sometimes called e-learning, is a formalized teaching and learning system specifically designed to be carried out remotely by using electronic communication. Because distance learning is less expensive to support and is not constrained by geographic considerations, it offers opportunities in situations where traditional education has difficulty operating [1]. Learners, practitioners and administrators and employees with scheduling or distance problems can benefit, because distance education can be more flexible, scalable in terms of time and can be delivered virtually anywhere [1]. Distance learning has a very crucial role in the acceleration of access of education suitably to students who have health, work, location or disabilities that hinder them to attend the face to face classes [2]. Presently there is an advocacy in increased advancement in the use of technology in the education sector, this has improved the levels of interactivity between students and faculty [15] and this has brought about many institutions adopting distance learning. For these institutions to further exploit the benefits of distance learning there must be a clear connection to cloud computing as this will act as good and effective accelerator to enhanced distance learning.

2. Related Work

The Cloud is a pictogram for the Internet, which is ascribed to the hosted services over the internet or more generally components which are managed by others as a cloud outline. The Cloud concept dates in early 1960 when John McCarthy derived an idea that "Computation may Someday be organized as a public utility". Cloud computing technology started coming up through the (SaaS) Software being used as a service. [1] describes a platform for educational computing using APIs and Node Managers. The APIs are used for writing data to files and sending them to networks and the Node Manager manages programs, stores information, and controls and allows inputs to be added, combined, split and changed. This provides access to data like the cloud at any node due to availability of wider bandwidth for communication.

3. Cloud Computing Framework

Cloud computing holds a vivid channel to change the ways that information technology resources such as education can be utilized.[7,8] assesses that cloud computing presents itself as a technology that can accelerate more complex and suitable innovation for computer industry. More virtualized resources can be made readily available due to its high scalability and users will require minimal knowledge to operate this. Cloud computing framework allows the resources to be viewed from two points, either the public cloud or private cloud. Public clouds are for external users while private clouds are for users within some given enterprise. The cloud based technology aims at reducing the number of servers (fig 1) through virtualization [6] and the focal issue based on either public or private cloud is to identify that the user can meet the expected demand for this infrastructure. Incorporating distance learning will provide a computing model since cloud computing is based on networks and internet [6]. The framework provides cloud clients a channel that provides a link to the applications which must be supported by the platform and the infrastructure. The framework at large provides three influential layers; SaaS, PaaS and HaaS. This will highlight Software as a Service, Platform as a Service and Hardware as a service respectively.

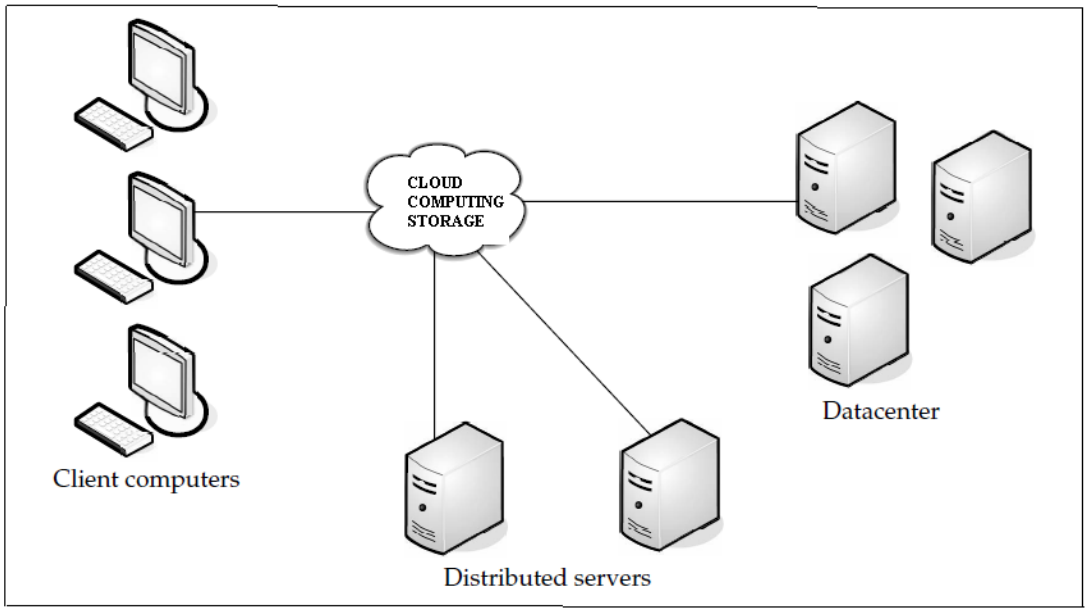

Fig 1. Cloud Computing Representation.

SaaS provides a model through which an application will be hosted to provide distance education clients with services. PaaS will give resources required to build services and applications whereas HaaS represents the infrastructure. In a topological reality a cloud computing architecture will comprise of distributed systems i.e 3 tiers, client computer, distributed servers and a data center with a client storage center.

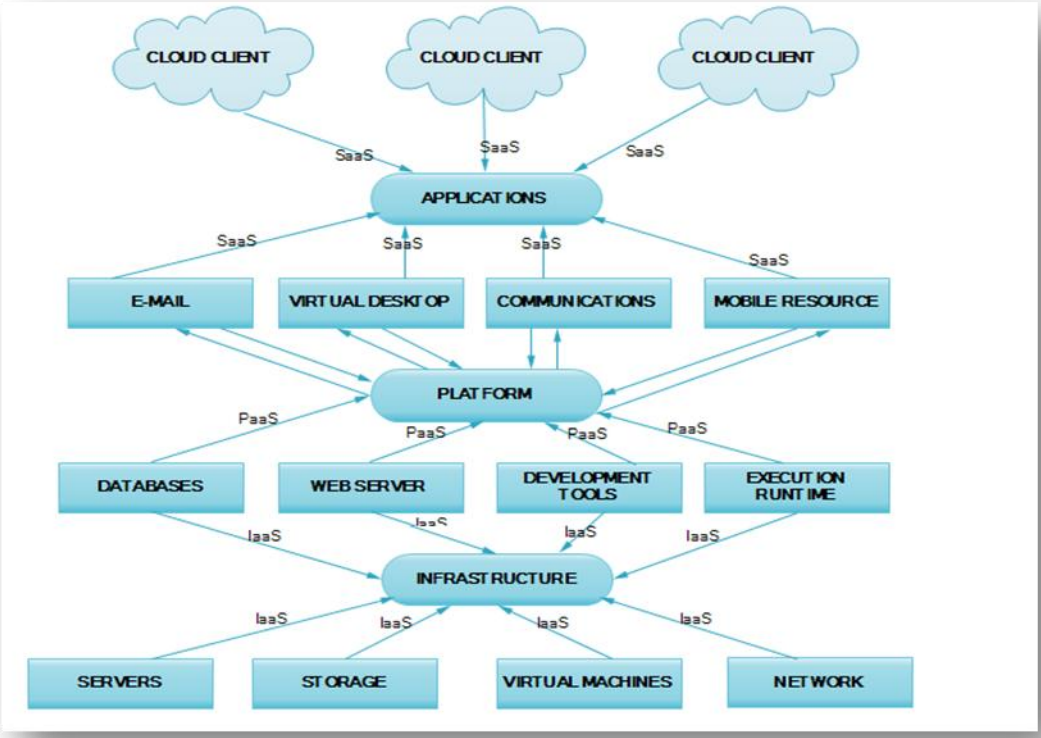

Fig 2.Framework of Cloud Computing representation with SaaS, PaaS, IaaS.

4. Cloud-Based Learning Architecture

[7] Describes the introduction of Cloud computing architecture in distance learning as a method that can be implemented to increase scalability and flexibility, however this instructional model will integrate the traditional classroom to become more dynamic and operational. To implement this model the cloud service will have a middleware, computer physical memory and a processor. All this modalities needs to be integrated with tools that will hasten the process of distance learning like; a set up for educational institutes, campus network architectures and web based technologies. The proposed architecture will yield numerous advantages like **[**15**]** powerful computing methods and storage capability, security and virtualization, this will be aimed at having an environment that will allow different pedagogical approaches [8]**.** The proposed architecture uses very limited resources. Learners and practitioners can interact by first by sending these resources [9] a REQ (request) to the server, the server will then authenticate the user by performing verification and thereafter user thereafter providing the service specified after sending an acknowledgement to the user.

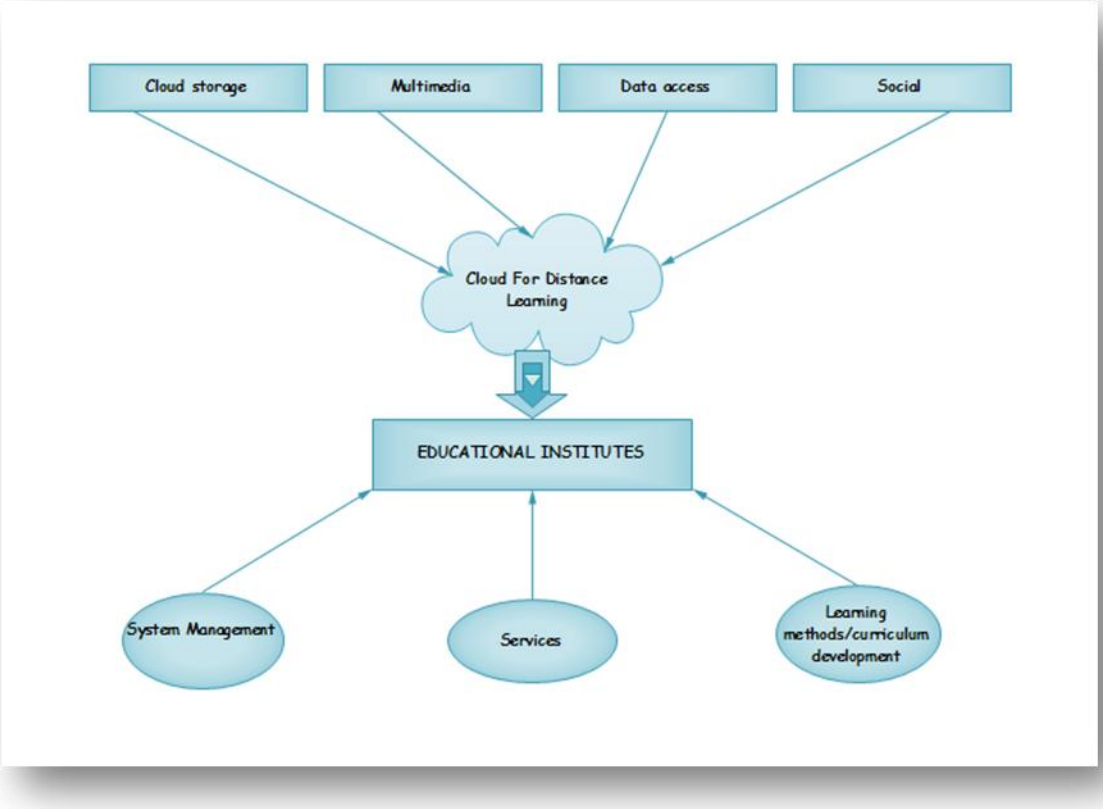

Fig 3.Cloud computing interconnection for educational Learning.

4. Implementing Cloud Computing In Distance Learning.

Vital concern shared by practitioners, learners and institutes in implementing cloud computing services is how well they integrate into their systems. Cloud computing relies on subsisting technologies like grid computing,

virtualization, web services and of course the Internet, to provide on-demand services [12]. These technologies must work harmoniously. Essentially there are three foundations upon which universities can implement cloud computing. These have been variously mentioned as Infrastructure as a Service, Platform as a Service (PaaS) and Software as a Service (SaaS).

Infrastructure as a Service (IaaS) allows the cloud to be used as a digital site where data can be stored and protected. It permits university administrators to more efficiency control their resources at much reduced costs [13, 14]. With IaaS, universities can avail access to enormous processing power, voluminous storage space as well as networking components and middleware.

Platform as a Service allows the cloud to be used as a platform where access to other services, and more advanced and more dedicated applications, can be made. Indeed, PaaS not only allows users to access advanced services but also allow creation of unique and new services which can in turn be hosted on the platform themselves [13, 14]. It is this very concept that makes cloud computing extremely versatile allowing users to use the cloud as a spring board where users can either use it to access other services, create that application or service, or both.

Software as a Service allows cloud computing users to make use of a wide range of applications and software online. Typically, the Internet hosts thousands of applications online some of which are free while others are not. SaaS gives users access to all these.

To implement cloud computing, the university will have to conduct business analysis, build a business case, source a cloud service provider (CSP), plan and implement the solution, possibly with the assistance of a third-party system integrator. The main concerns during the implementation phase is to ensure that the cloud meets business requirements in terms of functionality and performance, provide the expected efficiencies and benefits, adequately protect institutional information, comply with legislative and regulatory requirements and integrate with existing processes and systems .

The business analysis will lead to the creation of a business model will help universities determine factors such as performance and resource requirements, lifecycle cost estimation, and required risk treatment measures. The university should consider how they would counter cloud service disruption or cancellation. Towards this end, they should put in place robust business continuity and disaster recovery procedures. During this analysis stage a number of other considerations should also be understood. These include the user characteristics, the data characteristics in terms of size and quantity, the average usage rates or transactions per second, usage changes for the various system actors and scaling over time in terms of number of users.

The other concern is an assessment of risks and how they impact on the value proposition [14]. This will enable the institutions to ascertain the quality of the cloud solution, its value for money, its ability to seamlessly integrate without business or technical difficulties and its ability to enable business continuity after a disaster.

The business analysis and the risk assessment provide a basis for determining requirements in terms of functionality, industry-recognised standards, performance, manageability, security and compliance with legislative and regulatory obligations. Functional requirements for IaaS, will relate to the provision of processing speeds, memory, storage and operating systems. Those for PaaS, will specify the development and operating environment SaaS requirements will be specified in the same manner as those of non-cloud solutions. Performance is mainly examined from the user's perspective and metrics of interest from this perspective include availability, reliability, responsiveness and throughput. Manageability is considered mainly from the point of its ability to configure and manage cloud-based services. A security assessment should consider confidentiality, integrity, authentication, authorisation and threat management.

Institutions must also build a business case that provides justification for cloud solution weighed against other alternatives such as non-cloud solutions. The business case will also provide a reference point for re-evaluation in future. The next step would be to prepare an exit strategy which documents the institutions contingency plan to migrate records securely from one solution to another while maintaining business continuity. The migration may be from a non-cloud to a cloud platform or vice versa. Also to be prominently included is how data stored by the cloud service provider will be archived, where it will be archived, the method to transfer it, how it will be destroyed and how destruction will be verified together with the security requirements associated with these processes. Liabilities on either party should be clearly specified in the contract stipulations and cover breaches beyond the life of the

agreement. It cannot be overstated that before a binding contract is signed, prior understanding of the university's terms will provide a basis to ensure its business and security requirements are adequately met and perhaps exceeded.

With the foregoing settled, the institution should then determine the most appropriate model. Options for consideration include managed services, outsourcing, in-house delivery, cloud computing or a hybrid of either. The final decision depends on the business problem being addressed. With this done the institution will then proceed to put in place internal capabilities and resources needed to manage the cloud service on a daily basis. These operations include monitoring performance and service levels, responding to incidents and service disruption managing configuration documentation and coordinating planned upgrade and system outages.

5. Conclusion and Future Work.

This work presents a coherent approach to educational computing networks. Learners and practitioners experience the benefits of distributed systems on the internet around the world. Futuristic advancement of cloud computing will aim at attaining integrated multi-core processors and powerful implementation of virtualization thus leveraging the powerful hardware, expandable bandwidth for communication, which will further realize explosion of distance learning application domains. This will be adequate in resource contribution to distance learning. The architecture of Cloud computing reflects diversity, flexibility and scalability. In its implementation cloud computing will be effective in educational computing at a lower cost.

REFERENCES

[1] J.Cappos I.Beschastnikh, A.Krishnamurthy, T.Anderson. Seattle: A Platform for Educational Cloud Computing.

[2] H.Rajaei , A.Aldakheel, 2012. "Cloud computing in computer science and engineering education" American Society for Engineering

[3] M.Armbrust, A Fox,R Griffith,A.Josepth,R.Katz,A.Konwinski,G.Lee,D.Patterson,A.Rabkin,I.Stoika,M.Zaharia., Above the clouds: A Berkeley view of Cloud Computing, UC Berkeley EECS, (2009).

[4] K.Verma, S.Dubey, M.Rizvi,"Mobile Cloud A New Vehicle For Learning: m-Learning Its Issues And Challenges". International Journal of Science and Applied Information Technology (2012). Vol 1.No.3.

[5] D.Madan, A.Pant, S.Kumar, A.Arora. "E-learning based on Cloud Computing" International Journal of Advanced Research in Computer Science and Software Engineering.2012 Vol 2(2).

[6] S.Vitkar,cloud based model for e-learning in higher education. International Journal of Advanced Engineering Technology vol 9(3) 2012.pp.38-42.

[7] A.Masud, X.Huang. "An E-learning System Architecture based on Cloud Computing", World Academy of Science, Engineering and Technology2012.

[8] M. Al-Zoube,S. El-Seoud, M.Wyne. Cloud Computing based E-learning system. International Journal of Distance Education Technologies, Vol 8(2), 2010.pp 58-71.

[9] S. Noor, G.Mustafa, S.Chowdhury, M.Hossain, J.Fariha**.** A Proposed Architecture of Cloud Computing for Education System in Bangladesh and the Impact on Current Education System. International Journal of Computer Science and Network Security, 2010VOL.10 No.10.

[10] T.Govindasamy, Successful Implementation of e-Learning Pedagogical Considerations. Internet and Higher Education, Vol 4, 287-299.

[11] N. Sultan, "Cloud computing for education: A new dawn?" International Journal of Information Management, vol. 30, pp. 109-116, 2010.

[12] H. Wu, C. Dan, A. M'hammed, "Exploring Cloud Computing for Distance Learning", Online Journal of Distance Learning Administration, vol. 14, 2011.

[13] A. Fern´andez, D. Peralta, F. Herrera, and J.M. Ben´ıtez "An Overview of E-Learning in Cloud Computing", Workshop on Learning Technology for Education in Cloud (LTEC'12), pp 35-46, 2012.

[14] M. Jalgaonkar, A. Kanojia, "Adoption of Cloud Computing in Distance Learning", International Journal of Advanced Trends in Computer Science and Engineering, Vol.2 , No.1, pp 17-20, 2013.

[15] S.Satpute, B.Deora," Cloud-Based Storage for Education. Journal of Advanced Research in Computer Science and Software Engineering Vol 4 is 3 pp 77-80.

BIOGRAPHY.

Kebande Rigworo Victor ,works as a Lecturer and Researcher at Department of Computer Science ,Egerton University ,Njoro,Kenya.Currently pursuing PhD. He holds an MSc Computer Science(2009),MBA (2009)and Bsc(2007) computer science,from Periyar University and University of Madras,India.He has more than 10 research papers.His research interests are ,AI,software engineering,security and distributed systems.

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