Harnessing Cloud Computing Paradigm for Virtual Library Adoption in Tertiary Institutions in Nigeria

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Abstract

Virtual library facilities in any University improved information services delivery that supports qualitative learning and research in such institution. However, shortage of skilled manpower to manage and maintain existing ICT Infrastructure and erratic power supply to power the ICT equipment are identified as part of the challenges militating against virtual libraries implementation in Nigerian Universities. These have made it complicated for its effective maintenance and required utility throughput. This situation is further worsened by the increasing need for ubiquitous availability of electronic library services to clients as an inherent characteristic of virtual libraries, resulting to prohibitive establishment and operational cost for the tertiary institutions to meet up. This study tends to address the identified problems by harnessing the benefits presented by open source and cloud computing technologies for the development and management of virtual library in Nigerian tertiary institution. The model presented in this study is based on community cloud model that leverage open source platform as a service (PaaS) and software as a service (SaaS) model to provision and maintain virtual library services.
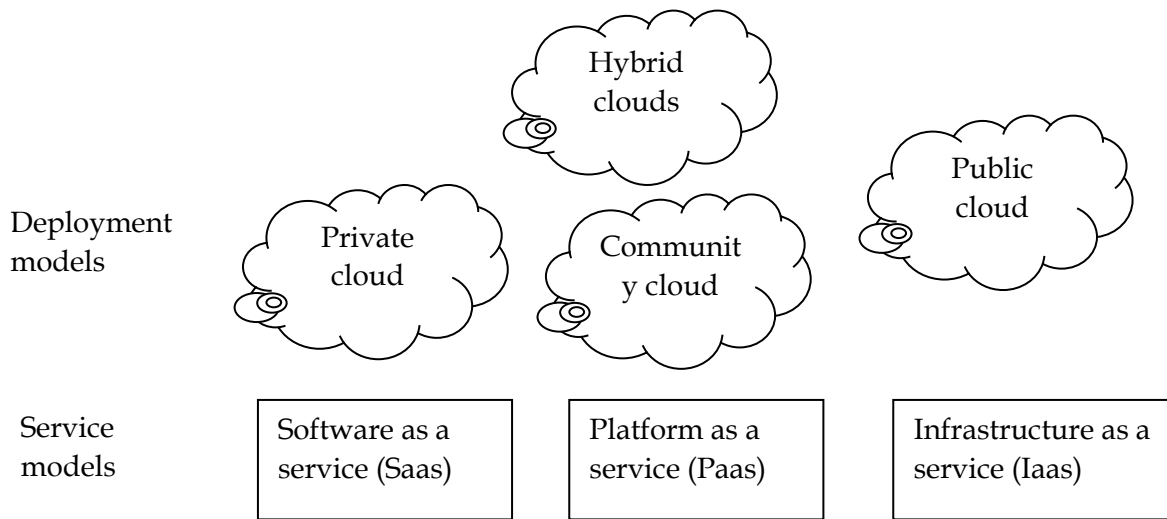
Keywords: Cloud Computing, SaaS, IaaS, PaaS, Library professionals.

1.0 INTRODUCTION

The emergence of open access, web technology, and e-publishing has slowly transformed modern libraries into digital libraries [3]. With this variety of technologies utilized, cloud computing and virtual technology has become an advantage

for libraries to provide a single library services. The end of the twentieth century witnessed modern advancements in Information and Communication Technology (ICT) that result to an information age which redefines how information is stored, organised, managed, rendered and accessed to serve the information need of the intended users [1]. This trend has given rise to the concept of Virtual Library often referred to as "electronic library," "library without walls" and "digital library" according to [2]. [4] defined the term virtual library as: "a national collection of digitized texts, distributed among institutions and accessible from anywhere at any time". [5] in [1] defined digital library as "a library in which collections resources are stored in digital formats (as opposed to print, microform, or other media) and accessible by computers." [6] states the characteristics of digital and virtual library as: "access to information over a network, facilitate immediate and simultaneous access to information, they are interactive, i.e. support two ways communication with the users, they exist in multimedia format of text, video, graphics, sound and animation. Above all, it increases speed and effectiveness in finding information and to decrease mental effort put into each search of information in the net". An analysis of the definitions and characteristics of virtual library presented suggests the deployment of digital library contents and automated library services over the internet as a requirement for fully harnessing its benefits. Cloud computing as defined by the National Institute of Standards and

International Journal of Research Available at
https://journals.pen2print.org/index.php/ijr/

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 06 Issue 10
September 2019

Deployment models

Hybrid clouds

Private cloud

Community cloud

Public cloud

Service models

| Software as a service (Saas) | Platform as a service (Paas) | Infrastructure as a service (Iaas) |

On Demand Self-Service	
Broad Network Access Resource Pooling	Rapid Elasticity measured Service
Massive Scale Homogeneity Virtualization Low Cost Software	Resilient Computing Geographic Distribution Service Orientation Advanced Security

Essential Characteristics — On Demand Self-Service; Broad Network Access Resource Pooling; Rapid Elasticity measured Service

Common Characteristics — Massive Scale, Homogeneity, Virtualization, Low Cost Software; Resilient Computing, Geographic Distribution, Service Orientation, Advanced Security

Technology is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. The Gartner Group [7] in [3] defines cloud computing as "a style of computing in which massively scalable and elastic IT-enabled capabilities are delivered as a service to external customers using Internet technologies."Practically cloud computing is synonymous with virtualization. Hence, cloud computing is a fast emerging technology that permits users to store files, share files and applications on the Internet. Akpan, A.G. [3], defined cloud computing as an elastic and scalable utility model that offers flexible, ubiquitous, on-demand network access to a shared pool of configurable computing resources (for example, servers, data centers, networks, applications and services) that can be rapidly

provided and released with limited interaction of service provider or the management. It provides shared infrastructure, self-service, dynamic and virtualized pay-per-use platforms which put it on high demand. Cloud computing implies a level of dynamic, flexible resource sharing and allocation of assets. According to Tuncay in [3], library can benefit from using cloud computing technology by increasing computing performance, storage capacity, universal accessibility and cost reduction. This can help library in terms of fixed and maintenance cost reduction in the IT investment of both hardware and software as well as computer services. With cloud computing, libraries may prevent financial waste, better track staff activities, and avert technological headaches such as computer viruses, system crashes, and loss of data. When cloud computing is used in the library, this will likely have a significant impact on library services. According to [3], with cloud computing, it becomes easier to access data with several devices. Especially for mobile devices, this can be really useful since the only thing that is needed is an internet connection. Libraries are shifting their services to cloud computing technology to facilitate its services anywhere and anytime. In libraries, the following have been identified as possible areas of applying cloud computing:

- Building Digital Library/ Repositories
- Searching Library Data
- Web Site Hosting
- Searching Scholarly Content
- File Storage
- Building Community Power and Library Automation.

Nevertheless, the biggest benefit of the adoption of cloud computing technology is that one does not "buy" the cloud as purchases for software and hardware and hitherto being made for library automation. Much like a common utility, one just pays for what was used, and then turn it off when one is done. The ability to have a server somewhere, to not have to worry about it, turn it up as needed, and pay for only what is used attracts a lot of people to cloud deployment. Library community can apply cloud infrastructure to amplify the power of cooperation and to build a significant, unified presence on the Web. This approach to computing can help libraries save time and money while simplifying workflows. To date, the main focus of libraries moving into the cloud has been due to, the need to disclose their vast collections [10].
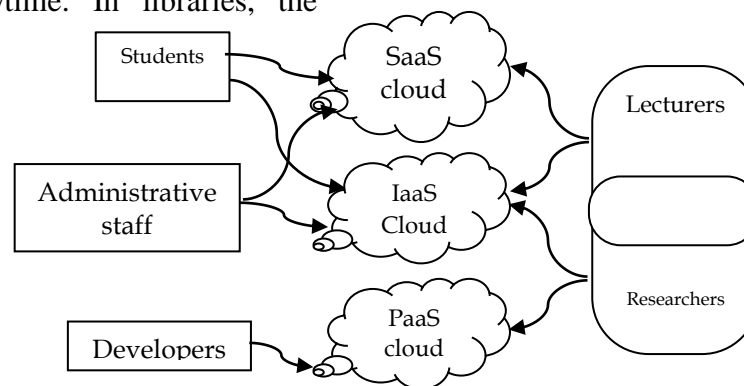

Fig.2: Simplified Structure of the Main Users of IT Services in a Typical University Now Using the Services of Cloud Computing [3]

International Journal of Research Available at
https://journals.pen2print.org/index.php/ijr/

e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 06 Issue 10
September 2019

Creeger [9], as cited in Gbaje and Aliyu [10], asserted that cloud computing comes into focus when there is need for increased capacity or added capabilities of computer without investing in new infrastructure, training new personnel, or licensing new software. Many search engines and social websites are using the concept of cloud computing like www.amazon.com, hotmail.com, facebook.com, linkedln.com etc. Cloud computing offers information retrieval systems, particularly digital libraries and search engines, a wide variety of options for growth and reduction of maintenance needs and encourages efficient resource use.

Cloud computing is an extra-large change that has robbed IT of its traditional obligations and empowered the end users with on demand utility computing. Cloud-based services are set to transform the way libraries work, unleashing librarians from the admin burden to focus on services for students and researchers [11].
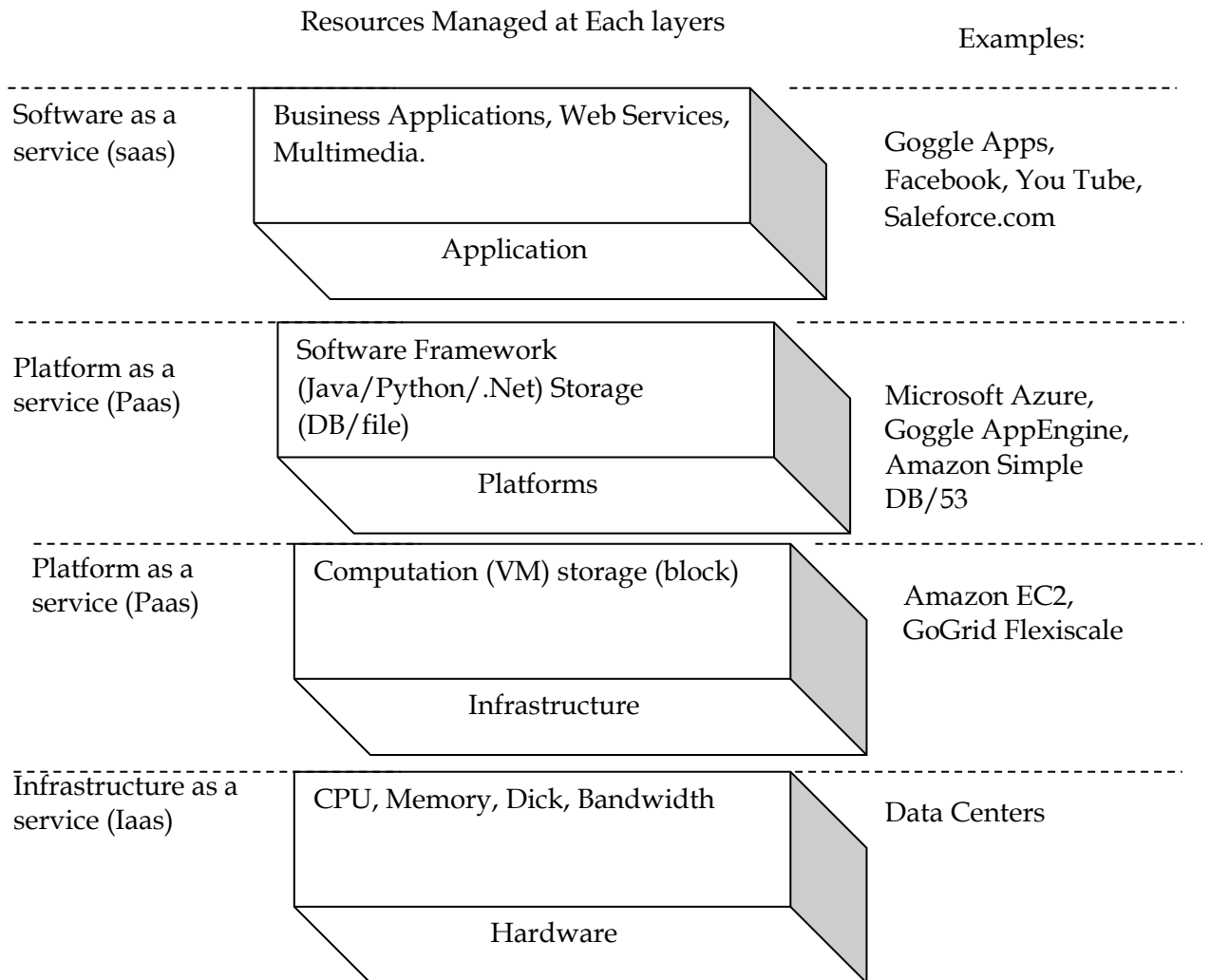

Fig. 3: Cloud Computing Architecture [16]

Fig.1: Cloud Computing Architecture [16]

2.0 Cloud Computing Initiatives in Nigerian Libraries

Libraries in Nigerian tertiary institutions as the heart of the institution they serve, supporting research and learning, are not left out in harnessing the opportunities presented by this trend. [12] reveals the gradual computerisation of Nigerian libraries in the universities through commencement of digitisation and establishment of library information network with connectivity through the university campus network to the Internet. Besides, [13] stating the report of IT News Africa, revealed the successful establishment of digital libraries in three (3) Nigerian Universities by Mobile Telephone Network (MTN) Nigeria. These Universities include: the Ahmadu Bello University, Zaria, the University of Lagos and the University of Nigeria, Nsukka. [14] had earlier revealed the launching of some Virtual Library Initiatives for Nigerian Higher Institutions by the Federal Government of Nigeria. [3] report the deployment of XLIB Library Management System in Ozoro Polytechnic Library, an ongoing Digital Library Project at Oghara Polytechnic, and the presence of ICT facilities in Ogwashi-Uku Polytechnic library, all in Delta State However, [1] identified shortage of skilled manpower to manage and maintain the required ICT Infrastructure and erratic power supply as part of the challenges faced by Virtual Libraries implementation. These have made it practically difficult for Virtual Library in Nigerian Tertiary Institutions to be effectively maintained and its benefits fully harnessed. Coupled with the fact that virtual library is characterised by round the clock availability, these challenges posed a prohibitive cost to the libraries as against the limited available funds.

This study tends to address the identified problems by harnessing the benefits of open source software and cloud computing in the deployment and management of virtual library in Nigerian tertiary institutions based on community cloud approach. We presented a cloud virtual library concept capable of implementing open source library management system on an open source cloud computing platform. Hence, migrating the cost of deploying, managing and maintaining the ICT infrastructure involved in virtual library operation to the cloud provider (i.e. government agencies). The only cost incurred by the consumers (i.e. tertiary institutions) is based on cloud resources usage or/and cost of deploying and maintaining the ICT infrastructure responsible for internet connectivity at their respective campuses. The rationale for virtual library implementation on cloud computing and open source technologies is also discussed in this work. Examples of Cloud libraries:

- OCLC
- Library of Congress (LC)
- Exlibris
- Polaris
- Scribd
- Discovery Service
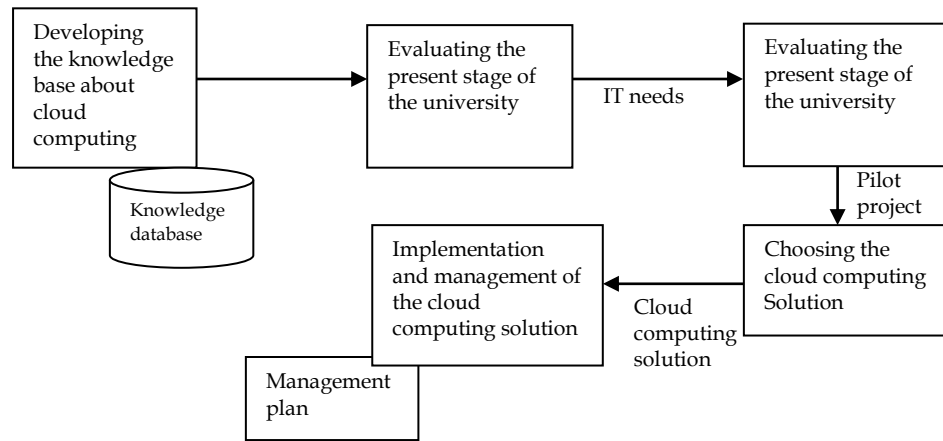- Google Docs / Google Scholar
- Worldcat
- Encore

Fig.4: Cloud Strategy in Higher Education [3

3.0
4.0 Deployment Models

a) *Private Cloud:* The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises [16]. A private cloud offers the highest degree of control over performance, reliability and security [23].

b) *Community Cloud:* The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it

may exist on or off premises [16]. This deployment model forms the basis of the model presented in this study, viewing Nigerian University Libraries as a community with the same or similar mission, security requirements, policy and compliance considerations.

c) *Public Cloud:* The cloud infrastructure is provisioned for the use of the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider. [3]. Public clouds offer several key benefits to service consumers, including no initial capital investment on infrastructure and shifting of risks to infrastructure providers.

d) *Hybrid Cloud:* The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by

standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds) [3]. Hybrid clouds offer more flexibility than both public and private clouds. Specifically, they provide tighter control and security over application data compared to public clouds, while still facilitating on-demand service expansion and contraction [3].

4.0   Benefits of Cloud Computing

- *Cost Savings:* Cloud computing save cost by providing an economy of scale from the providers view, demand view and multi tenancy view [12]. The cloud provider can increase the degree of sharing to reduce operating cost, while the consumers does not need to use high powered and a high priced computers to access the cloud resources.

- *Increased Storage:* Due to the rapid elastic nature of cloud computing, additional storage can be easily provisioned to support the increasing consumer's storage need with minimal human intervention (i.e automated). This makes the consumer feels they have access to unlimited storage facilities available on demand.

- *Flexibility:* Cloud computing supports organisational agility as consumers can pool and release cloud resources at any time to satisfy their information technological needs.

- *Mobility:* Since Cloud computing is characterised by broad network access over the Internet, cloud resources can be accessed anytime and anywhere. This projects cloud computing model to be a valid alternative to implement Bring-Your-Own-Device (BYOD) in learning.

- *Reduced Time for Implementation:* Cloud computing provides near real-time automated process for implementing new IT initiative when they occur unlike the traditional way that might take weeks or months to achieve.

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