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# Cloud Computing and Libraries

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**ABSTRACT**

Cloud computing is a new breed of service offered over the internet, which has completely changed the way one can use the power of computers irrespective of geographic location. It has brought in new avenues for organisations and businesses to offer services using hardware or software or platform of third party sources, thus saving on cost and maintenance. In this paper, an attempt has been made to give an overview of this technology, initiatives, advantages and disadvantages and the areas in which libraries can deploy this technology for providing services and augment the productivity of library staff.

**Keywords:** Cloud computing, Web 2.0, libraries

## 1. INTRODUCTION

Till recently, and now too many organisations and individuals use computers to work alone, inside a business or home by investing on hardware, software and maintenance. This scenario is slowly changing owing to the emergence of new breed of Internet services popularly known as Web 2.0, through which now one can use the power of computers at a completely different location, what it is popularly called as 'in the cloud' or 'cloud computing'. There are many synonyms for cloud computing such as, 'on-demand computing', 'software as a service', 'information utilities', 'the internet as a platform', and others[1]. Cloud computing refers to use of web for computing needs which could include using software applications, storing data, accessing computing power, or using a platform to build applications.

From e-mail, to word processing or photo sharing or video sharing one can use products that live in the cloud, which are secure, backed-up and accessible from any Internet connection. The best live example of this is Gmail, which is increasingly used by organisations and individuals to run their e-mail services. Google Apps being free for educational institutions is widely used for running different applications, especially the email services, which was earlier run using their own computer servers. This has saved cost for the organisations as they pay per use for applications and services and time for the computer staff, which they can invest on running other services and need not worry about upgrading, backup, compatibility, and maintenance of servers, which is taken care of by Google.

Libraries are using computers for running services such as Integrated Library Management Software (ILMS), website or portal, digital library or institutional repository, etc. These are either maintained by parent organisation's computer staff or library staff. It involves investment on hardware, software, and staff to maintain these services and undertake backup and upgrade as and when new version of the software gets released.

Library professionals in most cases not being trained in maintaining servers find it difficult to undertake some of these activities without the support of IT staff from within or outside the organisation. Now cloud computing has become a new buzzword in the field of libraries, which is blessing in disguise to run different ICT services without much of a problem as third-party services will manage servers and undertake upgrades and take backup of data.

Even though there are some concerns in using cloud services such as privacy, security, etc., some of the libraries have already embraced this new technology to run some of their services.

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## 2. WHAT IS CLOUD COMPUTING

Cloud computing is a new technology model for IT services which many organisations and individuals are adopting. It allows them to avoid locally hosting and operating multiple servers over an organisation's network and constantly dealing with hardware failure, software installation, upgrades, backup and compatibility issues and also enables them to save cost. In other words, it refers to "the delivery of computing as a service rather than a product, whereby shared resources, software, and information are provided to computers and other devices as a metered service over a network, typically the internet".[2] In this model rather than investing on hardware and software, organisations buy and pay for the services as needed basis. Cloud computing also helps to increase the IT requirements quickly and easily to accommodate the changes in demand. In other words, it enables organisations to add or remove hardware/software as per the needs just by requesting the service provider to do so.

The Christy & Carina[3] of Gartner Group define 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'. To simplify the concept, cloud computing can be defined as 'simply the sharing and use of applications and resources of a network environment to get work done without concern about ownership and management of the network's resources and applications'[4].

## 3. TYPES OF CLOUD COMPUTING

Cloud computing IT model has wider meaning as it essentially has three different types of services viz. SaaS, PaaS and Iaas.

### 3.1 SaaS (Software as a Service)

Saas is popularly known as software on demand. In this, applications or software is delivered as a service to the end user, who can access the program online using a web browser or any other suitable client. Here, service provider licenses an application to customers either as a service on demand, or through a subscription, in a 'pay-as-you-go' model, or at no charge. Some of such services are Google Apps, Salesforce, etc. There is usually little customisation or control available with these applications. However, subscribers benefit from low initial costs, have access to (usually 24/7) support services, and needn't worry about hosting, installing, upgrading, or maintaining the software[5].

### 3.2 PaaS (Platform as a Service)

Cloud computing has evolved to include platforms for building and running custom applications, a concept known as 'platform as a service' (or PaaS). PaaS applications are also referred to as on-demand, Web-based, or software as a service (or SaaS) solutions. In this, a computing platform supplies tools and a development environment to help organisations to build, test, and deploy web-based applications. It helps 'organisations not to make investment in the infrastructure required for building web and mobile applications, but can rent the use of platforms such as Windows Azure, Google AppEngine, and Force.com. Applications which are built using these provider's services. However, are usually locked into that one platform[6]. This service is delivered the way utilities like water and electricity are supplied, users have to simply 'tap in' and take what they need without worrying about the complexity. And like a utility, PaaS is based on a metering or subscription model so users only pay for what they use. With PaaS, one can focus on innovation instead of complex infrastructure[7].

### 3.3 IaaS (Infrastructure as a Service)

IaaS also referred as HaaS or (Hardware as a Service) offers both storage and computing power services. It delivers computer infrastructure i.e. a platform virtualisation environment as a service along with raw (block) storage and networking. In this, rather than purchasing servers, software, data-center space or network equipment, clients instead buy those resources as a fully outsourced service. Suppliers typically bill such services on a utility computing basis; the amount of resources consumed (and therefore the cost) will typically reflect the level of activity[2]. The best example of this service is Amazon's web services viz. Simple Storage Services (S3) for data storage and elastic compute cloud (EC2) for computing resources. Organisations are using Amazon's web services to host or backup their websites, for content delivery, to run high performance computing simulations, to host media collections and many other services. IaaS is priced on a pay-as-you-go model enabling clients to scale up or down the operations depending on their needs at any given time and pay only for what they use[5].

## 4. CLOUD COMPUTING INITIATIVES

There are good number of cloud computing initiatives undertaken by Amazon, Google, Microsoft and others offering various types of cloud computing services for the organisations, businesses, and individuals. Some services offered by these initiatives are:

### 4.1 Amazon Web Services (AWS)

Amazon is perceived as one of the major players in the business, offering a wide range of prominent cloud computing services such as elastic compute cloud (EC2),

simple storage service (S3), simple DB and simple queuing service (SQS). It provides a reliable, scalable, low-cost infrastructure platform in the cloud that powers hundreds of thousands of businesses in countries around the world[7]. Some of the solutions offered by Amazon through cloud computing include application hosting, web hosting, backup and storage, enterprise IT, content delivery, and databases. To help new users, Amazon also offers a free service for a period of one year on all its cloud computing services to launch new applications, test existing applications in the cloud, or simply gain hands-on experience with AWS.

### 4.2 Google Apps

Google Apps cloud services, a multi-tenant, internet-scale infrastructure, offers faster access to innovation, superior reliability, and security, and maximum economies of scale as compared to on-premises, hosted and software plus services technologies[8]. Google Apps is available free for individuals and organisations (limited up to 10 user accounts), educational institutions and US non-profitable organisations and for a price to businesses and organisations. Google apps offer Gmail, Google Docs, Google Sites, Google video and other services on the cloud. Google Apps helps organisations to move their e-mail services, web services and office applications on the cloud. In addition to Google Apps, Google also has 'Google App Engine' service, which enables organisations and businesses to build and host web apps on the same systems that power Google applications. It offers fast development and deployment; simple administration, with no need to worry about hardware, patches or backups; and effortless scalability[8].

### 4.3 Microsoft Windows Azure

Windows Azure is a cloud platform from Microsoft Corporation that empowers organisations to develop and run applications with unbounded scalability and ease-of-use. With this flexible platform one can easily scale up or down to meet the demands of business. With the pay-for-use business model, i.e., one is paying for the services which are actually used while one is not paying for the services which are not used. Windows Azure allows developers to develop and run applications quickly, while leveraging current skills to develop applications with .NET, PHP, or Java[9]. Some of the scenarios offered by Windows Azure for businesses and organisations include SaaS, storage, computing, database management etc.

### 4.4 Rackspace Cloud

The Rackspace cloud is a cloud computing platform that offers three types of services for organisations and businesses viz. cloud servers, cloud files and load balancers. Cloud servers are available to organisations in different sizes and are measured by the amount of physical memory reserved for an instance and range from 256 MB up to 30 GB on Operating system of their choice to run various web services. Cloud files provides an easy to use online storage for organisations to store files and media which can be delivered globally using Akamai's content delivery network (CDN). Its third service Cloud balancer helps organisations to enhance their server capacities and to balance the load factor and this service is extended only on-demand[10].

## 5. CLOUD COMPUTING INITIATIVES FOR LIBRARIES

Like all purpose cloud initiatives undertaken by giants, there are sizable number of initiatives relevant to libraries initiated by organisations and business houses, which are in the business of integrated library software, digital libraries, search engines, etc. Few major ones are:

### 5.1 OCLC's Webscale

OCLC has set an example for making use of cloud computing for libraries. Years together OCLC has been functioning as a cloud computing vendor because they provide cataloguing tools over the internet and allow member institutions to draw on their centralised data store[11]. Now, OCLC has geared to implement the plan of library management systems on the cloud in which OCLC has web-scale delivery and circulation, print and electronic acquisitions, cataloguing and license management components. Its worldshare management services (WMS) allows libraries to manage entire collection management life cycle in a cloud-based application. The overall purpose of webscale—sharing resources, data, and innovation—is supported by a variety of features that work together to save money, promote community development and drive better services for library users.

In other words, this will generate cost benefits for libraries and efficiencies not possible when utilising disparate, specialised systems[12]. The service promises to include privacy, security, scalability and technical support.

### 5.2 Ex-Libris Cloud

Ex-Libris a leading library software vendor from USA, who initially developed most of the current products as locally implemented solutions and at a later stage, adapted them to a hosted environment. The company's next-generation library system, Alma, was conceived as a cloud-based service to transform the traditional management of library resources. It besides ensuring considerable savings in total cost, involved in the implementation of software and the use of a centralised cloud service enables libraries to easily influence the collaborative efforts of the library community to provide

effective services for their users[13]. To provide worldwide cloud-based services; it has opened data centers at various locations. The company promises to adhere to data security, updates, and standards in implementing cloud services to safeguard the interests of customers.

### 5.3 Duraspace's DuraCloud

Duraspace provides open sourse repository solutions by undertaking turnkey projects for organisations and libraries to enable them to share scholarly literature using DSpace and Fedora Commons. It is dedicated in sustaining and improving Fedora and DSpace, two of the most dominant open source repository solutions. Its new service DuraCloud provides digital preservation support services in the cloud, which is cost effective and simple for libraries. DuraCloud helps libraries to move content to the cloud and store it with different service providers to eliminate the risk of data loss.

The cloud solutions offered include online backup, preservation and archives, media access, online sharing, and cloud broker[14].

### 5.4 OSS Labs

OSS labs from India is using Amazon's elastic cloud computing platform owing to the various capabilities of Amazon such as high durability of data, strong information security based on ISO standards, scalability, and flexibility. It is expected that the OSS labs will be able to provide robust open based solutions to demanding customers[15]. Using Amazon's cloud services, it is offering Koha ILS and DSpace institutional repository hosting and software maintenance subscription services for libraries. This has enabled cost-saving for libraries and also helping library professionals to be free from worrying about software updates and maintenance.

## 6. CLOUD COMPUTING APPLICATIONS IN LIBRARIES

Libraries are in a unique position to experiment with cloud computing given their service-oriented mission and need to find appropriate solutions using limited resources[16]. According to Fox,[11] "one of the key pressures that pushes libraries to cloud solutions and proves to be an impediment to the migration is the availability of IT support services. He also observes that goals and policies of organisation might also force libraries in making use of cloud computing services". These factors make SaaS and PaaS approaches appealing for libraries. However, according to Kroski[5], "libraries are experimenting with all types of cloud computing services including that of infrastructure services, i.e., IaaS". Libraries are using cloud computing in number of areas starting from federated search, website hosting, digital libraries, library automation, etc. Some of these are:

### 6.1 Automation

Automation is an area; most of the libraries keen to start in order hasten day-to-day operations. Until now, automation in libraries is being undertaken on locally hosted servers using different types of commercial and open source integrated library management software and managed either by internal IT or library staff. However, now many of the software vendors and third party services offering hosting of this service (SaaS approach) on the cloud to save libraries from investing on hardware. Apart from cost-benefit, the libraries will be free from undertaking maintenance such as software updates, backup, etc. For example vendors such as Ex-Libris, OSS Labs are offering this service on the cloud.

### 6.2 Digital Library Services

Digital libraries or institutional repositories have become part of modern libraries owing to changing format of information. The digital library services are presently being offered by libraries mostly using locally hosted open source software such as DSpace, EPrints, Fedora Commons etc for providing open access to scholarly resources. Apart from adding resources, this involve libraries to maintain the servers, undertake backup and carry on regular updates as and when the new version of the software is released thus putting lot of pressure on the library or IT staff. To relieve the libraries in undertaking this kind work, vendors are now offering digital library services on the cloud using SaaS approach. For example vendors such as Duraspace, OSS Labs, etc., are offering this service.

### 6.3 Office Applications

Libraries, at present, use various office applications such as word processing, spread sheets, power point presentations, etc. using Microsoft Office on the local computers. However, now owing to cloud computing there are many applications which are made freely available on the internet by companies like Google, Microsoft, etc. Google Docs, a free office applications suite available on the internet may be used in the libraries to undertake office operations, which also allows storing and sharing of resources with other colleagues, who can remotely work on the documents irrespective of their geographical location.

### 6.4 Storage

Libraries require space to store the electronic files and documents. The documents could be official correspondence, full text documents, bibliographic records, tutorials, etc. At present, these are stored and accessed using personal desktops or from servers which are locally hosted. The cloud computing has brought in plethora of new services, which offer space at no cost to

store the files and documents. For example, Windows Sky Drive offers 25 GB to store files and share documents online. Similarly, Amazon, DropBox and many more initiatives offer storage space on the cloud to enable organisations and individuals to store and share their documents. Libraries may take advantage of this and store some of their documents in order to undertake collaborative activities with other libraries. In regard to the digital preservation, libraries are making use of services of CLOCKSS (http://www.clockss.org/clockss/Home) and Portico (http://www.portico.org/digital-preservation/) to get permanent access to the subscribed content irrespective of the publisher's existence.

### 6.5 Search Services

Libraries have already migrated key services such as OpenURL providers, and federated and pre-indexed search engines on the cloud either by using commercial or open source solutions. For example, hosted Ex-Libris SFX Open-URL link resolver service offers libraries to link-up to the subscribed journal full-text articles.

### 6.6 Website hosting

Website hosting is one of the earliest adoptions of cloud computing as many organisations including libraries preferred to host their websites on third party service providers rather than hosting and maintaining their own servers. This is owing to either organisation's not having the required bandwidth of Internet (with static IPs) or technical manpower to maintain the servers. Google Sites serves as an example of a service for hosting websites outside of the library's servers and allowing for multiple editors to access the site from varied locations.

## 7. ADVANTAGES AND DISADVANTAGES

Like any other technology, cloud computing too has its advantages and disadvantages as compared to locally hosted services.

### 7.1 Advantages

Some of the advantages of cloud computing are:

- *Cost saving*

Cloud computing technology is paid incrementally thus saving costs for organisations. It offers price savings due to economies of scale and the fact that organisations such as libraries are only paying for the resources they actually use.

- *Easy on installation and maintenance*

No longer having to worry about constant server updates and other computing issues, organisations will be free to concentrate on innovation and the IT staff may concentrate on other tasks. There is no need to procure any hardware to run the servers.

- *Increased storage*

Cloud can hold more storage than a personal computer or the servers available in the libraries or organisations and it is possible to extend as per the need.

- *Highly automated*

The IT or library staff need not have to worry about keeping the software up-to-date. The cloud service provider takes care of updating software as and when new version is released. When the server is updated everyone using the service also get access to the new version without updating anything on their end[17].

- *Flexibility*

Cloud computing offers much more flexibility than other local network computing systems and saves time plus cost for organisations. It is possible for organisations like libraries to expand the services anytime, by requesting for an additional space on the servers.

- *Better mobility*

The staff and the users of the library can connect to the library servers from any place or from wherever they are, rather than having to remain present at their desks by having a PC and Internet access.

- *Shared resources*

One of the important components of cloud computing is that one can share the resources. It allows people within and outside the organisations to have access to the resources. A group of libraries can come together and can put their resources at one place, which in turn will enable them to provide access to more number of resources to their end users.

### 7.2 Disadvantages

Following are some of the main disadvantages of cloud computing:

- *Data security and privacy*

The biggest concerns about cloud computing are security and privacy, especially if the organisations are dealing with sensitive data such as credit card information of customers. If the proper security model is not yet in place, then the data stored on the cloud is vulnerable to attacks from viruses, theft, etc. In addition to that, since the services are offered over the Internet it is very difficult to assess the physical location of servers and software and security audit is hard to undertake. Also, there is a risk of data loss owing to improper backup and systems failure.

- *Network connectivity and bandwidth*

Since the cloud computing is offered over the Internet, if the connection goes down due to any reason then the organisations suffer from loss of data connectivity till the time it is set. Also the service requires more bandwidth, as it may not work on low-speed Internet connections[18].

- *Dependence on outside agencies*

The cloud services being offered by third party services over the Internet, it is virtually difficult to have any control on the maintenance levels and the frequency. Also it is tough to assess the contingency procedures of the service provider in regard to backup, updates, restore and disaster recovery. Migration to other service provider is also an issue, if the uniform standards are not followed by the host.

- *Limited flexibility*

Flexibility may be limited in terms of special customisation as services on the cloud will be common for all the customers.

- *Cost*

Initially the cost could be higher, but may reduce depending on the usage of services. However, organisations may end up paying higher charges in the future.

- *Knowledge and integration*

Deeper knowledge of cloud computing is essential as working of the service is totally dependent on the service provider. Similarly, integration is an issue as it will be difficult to integrate equipment used in data centers to host data with that of peripheral equipments in the organisation such as printers, USB drives, etc.

## 8. CONCLUSIONS

Cloud computing is a new baby in the computer systems technology emerged owing to the developments in internet and associated technologies. It is in the evolving stage, requires some amount of careful considerations before organisations think about hosting some of their services. However, this technology has certain advantages, which definitely help organisations such as libraries in managing their services, which will relieve library staff from managing the servers.

Library professionals many a times find it difficult to manage the technologies owing to their skill levels, lack of support from IT departments or for not having IT facilities within the organisations. This kind of situation always hinders library professionals in undertaking automation of library activities, developing digital library services, etc. Here, cloud computing may help libraries to undertake modern ICT activities without worrying about technical side of it, except adding content of resources. Libraries have taken a big leap in adopting this technology especially in the West, but surely it will slowly spread to developing countries. It is evident from the literature that some service providers have already pitched in to help libraries to automate and establish digital libraries on the cloud.

## REFERENCES


1. Hayes, B. Cloud computing. *Communications of ACM,* 2008, **51**(7), 9-11.

2. Wikipedia. Cloud computing. http://en.wikipedia.org/wiki/Cloud_computing (accessed on 12 December 2011).

3. Christy, Pettey & Forsling, Carina. Gartner highlights five attributes of cloud computing. 2009. http://www.gartner.com/it/page.jsp?id=1035013 (accessed on 28/12/2011).

4. Scale, Mark-Shane E. Cloud computing and collaboration. *Library Hi Tech News,* 2009, **26**(9), 10-13.

5. Kroski, Ellyssa. Library cloud atlas: a guide to cloud computing and storage/stacking the tech. *Library Journal,* 2009. http://www.libraryjournal.com/article/CA6695772.html (accessed on 15 February 2011).

6. Colayer. What is Paas? 2009. http://ex.colayer.com/_cached/LINK_whatispaas/LINK_whatispaas.html (accessed on 29 December 2011).

7. About AWS. 2011. http://aws.amazon.com/what-is-aws/ (accessed on 4 January 2011).

8. Google.com. Google App Engine. 2011. http://code.google.com/appengine/ (accessed on 2 January 2011).

9. Microsft.com. Cloud Platform. 2011. http://www.microsoft.com/en-us/cloud/cloudpowersolutions/development-and-hosting.aspx?fbid=oaQUdO25BEm (accessed on 19 March 2011).

10. Rackspace.com. The Rackspace Cloud. 2012. http://www.rackspace.com/cloud/ (accessed on 1 June 2011).

11. Fox, Robert. Libraries in a cloud. *OCLC Sys. Serv.,* 2009, **25**(3), 156-61.

12. OCLC. OCLC Worldshare management services. 2012. http://www.oclc.org/webscale/overview.htm (accessed on 6 January 2012).

13. Kozokin, Sarit. Ex-Libris cloud: Open for business. 2011. hhttp://www.exlibrisgroup.com/?catid={BC76

D337-FEFA-4603-B827-28AB9F818BDB} (accessed on 8 January 2012).

14. Duracloud.org. Duracloud. 2012. http://www.duracloud.org (accessed on 8 January 2012).

15. OSS Labs. OSS Labs to host its solutions on Amazon's cloud computing platform. 2011, http://www.osslabs.biz/news/oss-labs-host-its-solutions-amazons-cloud-computing-platform (accessed on 13 March 2011).

16. Mitchell, Erik. Using cloud services for library IT infrastructure. *Code4Lib Journal*, 2010, 9. http://journal.code4lib.org/articles/2510 (accessed on 8 January 2012).

17. Webhostingreport. The advantages of cloud computing. 2011. http://www.webhostingreport.com/learn/advantages-of-cloud-computing.html (accessed on 1 January 2011).

18. Miller, Michael. Cloud computing pros and cons for end users. 2009. http://www.informit.com/articles/article.aspx?p=1324280&seqNum=2 (accessed on 20 December 2011).