Academic Libraries and Cloud Computing

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Abstract

In library and information, first revolution came when automation started in most of the libraries. The main objective of this article is to give a basic overview of Cloud Computing and try to clear up some confusion on using the same. This paper also tries to present Cloud Computing in such a way that library community can understand it easily and make librarians to think on using it for designing and providing different services with modern infrastructure and technology.

Keywords: Academic Libraries, Cloud Based Library Services

1. Introduction

As ICT has made a huge impact on library users and the way they need information. Nowadays they are very comfortable with their PCs, laptops, tablets, and their smart mobile devices. Recently ACCENTURE, one of the renowned IT management consultancy has conducted a very interesting survey on electronic products and services, which people would like prefer to use or buy in next one year and finds that consumers are likely buy fewer but multiple-function devices like smart phones and there are drastic increase in the use of Cloud-based services and applications i.e. Online mailbox service, Online photo-video storage, Online Document Creation, Online Calendar and many more for their daily use. If one critically looks at the success of Facebook, why did Facebook succeed and MySpace failed. The success mantra is "Sharing and Innovation". In fact, Dr. Ranganathan's fourth principle very much applied when we say Cloud Computing. Save the time of reader by providing information anytime anywhere.

The services should be design in such a way that a user gets it 24x7 if having good internet connectivity. American multinational Computer Technology Company Dell is currently working on a project called "Ophelia", a potentially game changing device that is essentially a virtual computer that can be accessed anywhere. At the moment, a user can use any computer to check a web email account or update their FB status, but this project Ophelia would allow a user to access their own computer and its applications on any connected devices. So now it is time for librarian to concentrate on providing pro-active services and move from general service to personalise information services to the users for the benefit of academic community rather than hunting for technology to deliver the services.

2. Cloud Computing

2.1 Brief History of Cloud Computing

Everywhere there is a talk about Cloud Computing and it feels that it has newly born technology, but the reality is that it has gone through decades of slow evolution. If one really wants to understand Cloud Computing, one must understand the evolution of computing from historical perspective focusing some

basic advances that actually led to the development of Cloud Computing, such as transition from ENIAC to desktop, laptop, mobile and now smart phone tablets. Likewise, in the late of 1950s, when computers were massive and costly, hardware and computer time-sharing technology emerged as a new sharing technology. In 1961, Prof. John McCarthy suggested that computer time sharing technology might lead to a future where computing power and even specialised application might be sold through utility type model. Unfortunately this idea faded away when it realise that information technology were actually unable to sustain this computing model and these hazy visions remained dreams, because even their proponents knew they lacked an efficient delivery mechanism too. But time has changed now and technology is growing very fast, and the term "Cloud Computing" itself is emerging as a revolutionary technology in the world of ICT. The universal internet connectivity solved that service delivery problem. In 2002, Amazon was the first major cloud provider, with the 2006 offering of Amazon Simple Storage Service (Amazon S3). Other cloud providers include Apple, Cisco, Citrix, IBM, Joyent, Google, Microsoft, Rackspace, Salesforce.com, and Verizon/Terremark.

Key Players in Cloud Computing Platforms (adapted from Lakshmanan (2009))			
Company	Cloud Computing Platform	Year of Launch	Key Offering
Amazon.com	AWS (Amazon Web Services)	2006	Infrastructure as a service (Storage Computing), Datasets and Content Distribution
Microsoft	Azure	2009	Application platform as a service (.Net, SQL data services)
Google	Google App. Engine	2008	Web Application Platform as Service
IBM Salesforce.com	Blue Cloud Force.com	2008	Proprietary 4GL Web application as an demand platform

2.2 Concepts of Cloud Computing

Cloud computing "is a phrase that is being used today to describe the act of storing, accessing, and sharing data, applications, and computing power in cyberspace". - Pew Internet Trust.

A web Service "is a software system designed to support interoperable machine –to – machine interaction over a network"-w3c.org

In generic term, cloud computing can be defined as "a model for enabling ubiquitous, 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." (NIST)

"cloud computing as a style of computing in which scalable and elastic IT-enabled capabilities are delivered as a service using Internet technologies"- Gartner IT Glossary.

In simple term Cloud Computing is a technology that basically using virtual servers as infrastructure and that have been made available to the third parties via the internet.

2.3 Types of Cloud Computing Services

♦ **Software as a Service (SaaS):** When you purchase any software and installed on a personal computers, is something called Software-as-a-Product. Software-as-a-Service is a software distribution model in which applications are hosted by a vendor and made available to customers over a network. SaaS applications are generally priced based on the number of users that can have access to the service. You might have to pay extra fees for the use of help desk services, extra bandwidth or sometimes for storage, if used. Examples: Gmail, Dropbox and Citation Management Software (Mendeley).

♦ **Platforms as a Service (PaaS):** Cloud Computing has evolved to include platform for building and running web-based applications, a concept known as Platform-as-a-Service. It offers a faster, more cost effective model for application development and delivery, and provides the entire infrastructure needed to run applications over the internet. PaaS is based on subscription based, so you have to pay only for what you use. Example: Google Apps Services, Google Doc, and Worldcat.

♦ **Infrastructure as a Service (IaaS)**: According to Wikipedia, Infrastructure as a Service (IaaS) is the delivery of computer infrastructure as a service. It leverages significant technology, services, and data center investments to deliver IT as a service to the users. IaaS service providers manage the transition and hosting of selected library applications on their infrastructure. Librarians maintain ownership and management of their application(s) while off-loading hosting operations and infrastructure management to the IaaS service provider. The following things are entrusted by the IaaS service providers:

    1.   Computer hardware

    2.   Computer network (including routers, firewalls, internet-users load balancing etc.)

    3.   Internet connectivity

    4.   Service level agreements and many more.

Rather than purchasing servers, software, network equipment etc., librarian can rent those resources as a fully outsourced service. Usually, the service is billed on a monthly basis, just like your telephone or electricity bills. Example: Amazon, Rackspace, Digital Commons, and VMware.

2.4 The Chief Benefits of Using IaaS are

1. Ready access to a preconfigured environment that is generally ITIL-based. (The Information Technology Infrastructure Library (ITIL) is a customised framework of best practice designed to promote quality computing services in the IT sector.)

2. One can get benefits of latest available technology for infrastructure equipment.

3. Lower costs that allow you to expensing service costs instead of making capital investments.
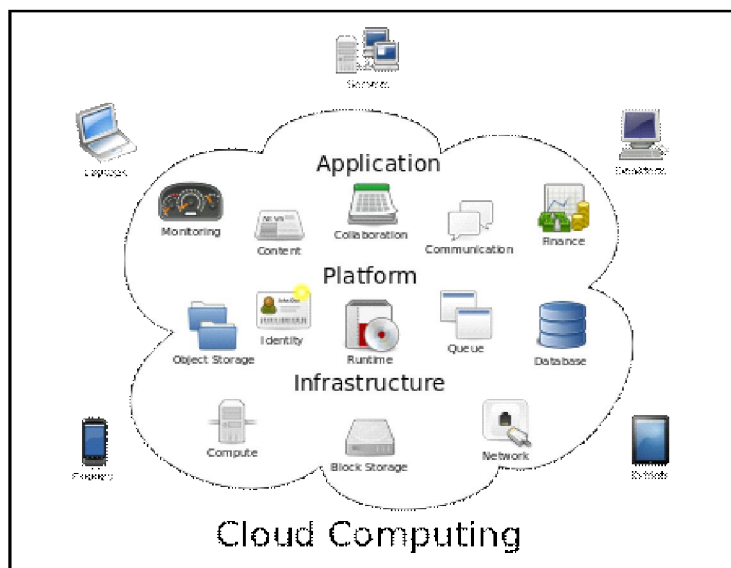

Figure1: Cloud computing logical diagram from Wikipedia

2.5 Cloud Deployment Models

There are four primary cloud deployment models. Each deployment model necessarily exhibits the previously discussed essential characteristics. The basic differences lie in the scope and access of cloud services, as they are made available to end users.

♦   **Public Cloud** - A public cloud is a publicly accessible cloud environment owned by a third-party cloud provider.

♦   **Community Cloud** - A community cloud is similar to a public cloud except that its access is limited to a specific community of cloud consumers.

♦   **Private Cloud** - A private cloud is owned by a single organisation.

♦   **Hybrid Cloud** - A hybrid cloud is a cloud environment of two or more different cloud deployment models.

2.6 Characteristic of Cloud Computing

A report published by the University of California Berkeley summarised the key characteristic of Cloud Computing as: "(1) The illusion of infinite of computing resources; (2) the elimination of an up-front commitment by cloud users; and (3) the ability to pay for use as needed". Further most important characteristic of Could Computing are listed below.

1. The system is able to cope up with Hardware and Software technologies as and when it is updated or become available.

2. Uniformity in data is one of the most important characteristics of the Cloud Computing.

3. More efficient and speedy distribution of library services with lower cost.

4. Simultaneously multiple users can use provided resources and services.

5. Constant performance that is monitored by the service provider.

6. Dynamic allocation of CPU, Storage, and Network Bandwidth.

7. Migration

8. Easy Healing, in case of failure

3. Cloud Computing and Academic Library Services

Library Services

1. Data: Bibliographic, digital technical, administrative, license access, preservation.

2. Content: Collections, subscriptions, digital print, publishing.

3. Services: Library as place, content access, content creation, instruction, research, preservation.

4. Experience: Research , Study support, peer based collaboration ,IT exploration

Cloud Based Library Services

Cloud computing nowadays received a significant attention as it has ability to change the way librarians are providing services to their users with emerging technologies and demands for the information. A recent study shows that Cloud Storage Subscriber numbers are increasing and it is forecast that by 2017 number of subscriber will reach up to 1.3 billion.

Cloud Computing not only brings some new service model for libraries, but also cause major impact on hardware and maintenance too. By using Cloud Computing, one can get out of the business of buying physical server, configuring, installing, and maintaining on the premises unless there is a genuine need or security of data is on high priority. So, most and foremost purpose of the Cloud Computing is allowing you to concentrate on research output and development of innovative services instead of technology to deliver these services and infrastructures for the users. Before going to Cloud, one should have an idea about pricing and other costs involved for the storage and services. Here are the popular storage services and comparison (annual costs).

Storage Service Comparison on a Annual Basis			
Service Provider	**Free**	**First Payment tier**	**Second Payment Tier**
Amazon	5GB	20GB ($10)	50GB ($25)
Apple iCloud	5GB	25GB ($40)	50GB ($100)
Box	5GB	25GB ($120)	50GB ($240)
Dropbox	2GB	100GB ($100)	200GB ($200)
Google Drive	5GB	25GB ($30)	100GB ($60)
Microsoft SkyDrive	7GB	27GB ($10)	57GB ($25)
Mega	50GB	400GB ($120)	2TB ($240)

Being a new and emerging area cloud computing has generated much interest in library applications. Predictions are that within five years, all library collections, systems and services will be driven into the cloud. We can design or develop many innovative services and play a vital role in promote research activates and support academic services. Most powerful advantage of Cloud Computing is that it enables the libraries to stop dealing with technical issues that have nothing to do with their day to day mission and services. Many of these Cloud based applications are listed here, and one can explore and implement as per the nature of the libraries keeping in mind the need of their users. A selected such cloud computing application and services, which we feel our library community can explore and overall enhance their servicers, are presented here.

4. Google Apps

After Amazon and Microsoft, Google are now emerging as very powerful Cloud service provider which provides not only Cloud based services but also offering many important applications which community can adopt for to boost up their services.

1. Google Sites: One can design, a fully featured website using Google Site. A very rare collection would be scanned into compressive, easily and most important searchable documents and can be made

available to the researchers. In fact all news items and other institutional documents can be scanned and put it into Google Sites without paying any money.

2. Google Calendar: You can create your own library calendar for entire year with upcoming events list.

3. Google Form: Google Form will "help you plan events, send a survey, give students a quiz, or collect other information in an easy, streamlined way. A Google form can be connected to a Google spreadsheet. If a spreadsheet is linked to the form, responses will automatically be sent to the spreadsheet."

4. Google Chat: A reference librarian can use this chat service for providing ONLINE Information assistance for their users

5. Google Doc: You can create your own documents and simultaneously multiple users can edit its contents and share at a time. Registered users can submit or edit or view it.

5. Mendeley (Reference Management Software)

Mendeley is a free reference manager and academic social network that can help you organise your research, collaborate with others online, and discover the latest research.

♦ **Dropbox** is a file hosting service operated by Dropbox, Inc., that offers cloud storage, file synchronisation, and client software. Dropbox allows users to create a special folder on each of their computers, which Dropbox then synchronises so that it appears to be the same folder (with the same contents) regardless of which computer is used to view it. Files placed in this folder also are accessible through a website and mobile phone applications.(Wikipedia)

♦ **Youtube** is now the leader in online video, and premier destination to watch and share original videos through internet, mobile devices, and email. It allows you to easily upload and share video clips on the YouTube website. Moreover there is tools called YouTube API, which enable you to integrate YouTube's video content and functionality into your website, software application or devices. Most of the NPTEL Videos are made available on YouTube.

♦ **Zimbra** Yahoo! Zimbra Desktop is a free, open source email and calendar client which runs on any windows, Apple, or Linux desktop computer. It works online and offline both and also can be synchronise with smart phones such as iPhone and BlackBerry.

♦ **iBookshelf** is your personal portable library reference. A comprehensive book database created and continuously maintained through extensive feedback from readers like you.

Books are displayed sorted by your preference. You can search for books in your library, and enter a "loan status" to remember who you loaned the book to or borrowed it from. A new book can be entered automatically (enter ISBN and remaining data is loaded from the internet) or manually. It will even tell you where you can buy the book and how much it costs and where you can find a library with the book!

Facebook (FB) is a popular free social networking website that allows registered users to create profiles, upload photos and video, send messages and keep in touch with friends, family and colleagues. The site, which is available in 37 different languages, includes public features. It also gives platform for developing your own page and marketing. FB application can be used by library in providing latest updates and what is happening in the library. In fact live reference chat service also can be provided by library using FB. .

6. Microsoft Office 365

It is a paid service by Microsoft office and you can access Microsoft office anywhere and at any time. One can communicate by Audio, Video Conference, and IM. Free trial is available on website.

Example of Cloud Libraries

1. OCLC
2. Library of Congress
3. ExLibris
4. Polaris
5. Scribd
6. Discovery Science
7. Google Doc and Scholar
8. Worldcat
9. Encore

7. Advantages

1. **Cost Saving:** Pay for what you use: 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 and also reduce infrastructure cost from 70-30% of budget.

2. **Easy on Installation and Maintenance:** No need to worry about constant performance of server, monitoring and updates on available latest technology. Library staff can spend more fruitful time for creating new innovative sharable services. It will also reduce the power consumption as physical servers are not residing on your premises. So, there is no need for separate server room and no need to purchase UPS, Batteries or Air Conditioner and maintaining the same.

3. **Increased Storage:** We all are agreed with the 5th law of library science given by Dr. Ranganathn "Library is a growing organism" So when your collection grows, you need more space for storage and retrieval. You can store more data on cloud than your personal network as it has unlimited storage capacity.

4. **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.

5. **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.

6. **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.

7. **Shared Resources:** One of the important components of cloud computing is that one can share the resources and intensify the power of cooperation. If you look at the data of 10 academic libraries in a particular state, more or less they have common subscriptions. Cloud Computing will allows people within and outside the organisations to have access to the resources at any point of time and anywhere in the world, as long as the connection of internet with good bandwidth is available. 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.

8. **Back up and Restoration:** Back up of the Cloud can protect all kinds of your library data from loss of owing to fire, flood, or any other natural or man-made computer related disaster that could cause data to disappear. You can easily restore your data if back is done and placed at the safest place.

8. Issues

Main issue is internet and electricity is must. Following are some of the main issues of cloud computing:

1. Data security and privacy: Major concern 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.

2. Network connectivity and bandwidth: Internet connectivity or problems with Internet Service Providers are very rare, but if occurs, and you may not be able to access your application, data or services till the time it is set. Also to run the services on Cloud Computing 1 MBPS bandwidth internet speed is desired as it may not work on low speed internet connection.

3. 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.

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

5. 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 future.

6. 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 centres to host data with that of peripheral equipments in the organisation such as printers, USB drives, etc.

7. Service Unavailability due to Power Outage: If there is no power supply it is difficult to get access to application and services. Entire library housekeeping operations can interrupt due to power outage.

8. Long Term Stability of Service Provider: If service provider disconnect its services or quit business, it may be very difficult to migrate all data from one cloud to another as compatibility issues are involved in it. So stability of service provider is equally important.

9. Conclusion

Cloud Computing is in a period of strong growth, but this technology still has some issues of security, and somewhat it is immature. Government Technology Research Alliance (GTRA) research showed that the most common concern about implementing Cloud Computing technology was security. But over a period of next few years, Cloud Computing will become the most promising technology. The real value of cloud computing is that it makes your library related software and data available transparently and everywhere (including latest available smart phone and other devices). Countries like India face problems like digital divide and low internet bandwidth. So benefit of new technology can be available to a limited extent in educational area. Recalling the evolution of library and the terms used for it like "Paperless library", "High-tech Library" etc, it near future we may have another the "Cloud Library".

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