

Concept & Applications of Cloud Computing in Libraries

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Abstract: Libraries continue to be not only early adopters of new technologies, but also early users of cutting edge technologies they see as being effective to their mission of providing information for all. In recent years, cloud computing has clearly proven to be a lasting technological innovation that will continue its rise in usage. This is an attempt to explore the concepts among the academic libraries on cloud computing and its association with the libraries. Cloud computing is not an exception in changing the world. Cloud computing provides us virtually unlimited and on demand computing resources. The infrastructure of cloud computing is such, that it encourages the development of innovation in every field. One such application of cloud is in academic libraries.

Keywords: Cloud Computing, Software, SaaS, PaaS, IaaS, OCLC, Library data, Data security.

I. INTRODUCTION

Today in this technological era, Information is exploring in large scale and information needs of the users are also growing rapidly. To meet the peculiar information needs of the knowledge society and to provide better services libraries are adopting many new technologies. The recent technology trend in library and information centres is the use of cloud computing as a strategic tool for the purpose of providing seamless library services with quality in a cost effective or economic way. In Information technology industry cloud technology is the third revolution after Personal computer (PC) and Internet. Cloud computing provides the user to use various applications without installation of that application in their own computer to access their personal files or official documents. Cloud computing is capable of bringing together collection of documents and resources stored in various personal computers, personal server and other equipment in to one place and putting them on the cloud for the use of the user community. Cloud computing is so named because the information being accessed is found in the "clouds", and does not require a user to be in a specific place to gain access to it. In this era undoubtedly Cloud Computing is one of the hottest and value added term in the field of Computing and Libraries.

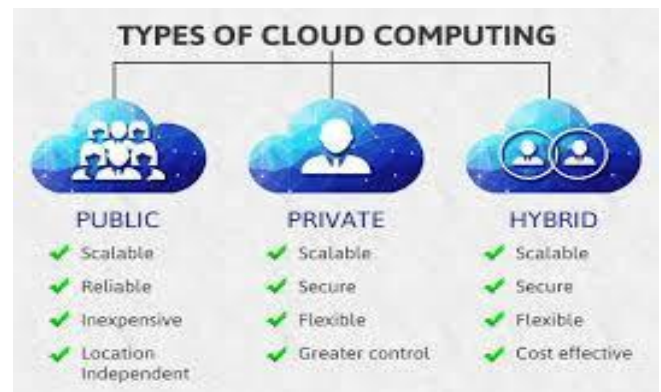
Objectives:

1. To examine the concepts of cloud computing among libraries.
2. To determine the scope of cloud computing in Libraries.
3. To examine the opportunities and threats for LIS professionals as emerged from the origin of Cloud computing platforms.
4. To identify the Application of Cloud computing in Libraries.

II. WHAT IS CLOUD COMPUTING?

Cloud Computing is a type of Internet-based computing that provides shared computer processing resources and data to computers and other devices on demand. It is a model for enabling ubiquitous, on-demand access to a shared pool of configurable computing resources (e.g., computer networks, servers, storage, applications and services), which can be

rapidly provisioned and released with minimal management effort. Cloud computing and storage solutions provide users and enterprises with various capabilities to store and process their data in either privately owned, or third-party data centers that may be located far from the user ranging in distance from across a city to across the world. Cloud computing relies on sharing of resources to achieve coherence and economy of scale, similar to a utility (like the electricity grid) over an electricity network.



III. MODELS OF CLOUD COMPUTING

There are three major types of cloud service models available:

A. Software as a Service (SaaS)

Applications or software is delivered as a service to the customer who can access the program from any online device. Some of these Web-based applications are free such as Hotmail, Google Apps, Skype, and many 2.0 applications, while most business-oriented SaaS, such as Sales Force, is leased on a subscription basis. There is usually little customization 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.

B. Platform as a Service (PaaS)

With PaaS, a computing platform is provided which supplies tools and a development environment to help companies build, test, and deploy Web-based applications. Businesses don't need to invest 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.

C. Infrastructure as a Service (IaaS)

This type of cloud computing is also sometimes referred to as HaaS or Hardware as a Service and it involves both storage services and computing power. Amazon's Web Services, one of the major players in this area, offers two main products including the Elastic Compute Cloud (EC2), which provides computing resources, and Simple Storage Service (S3) for data storage.

Application of cloud computing:

- i) Clients to access their applications and data from anywhere and anytime.
- ii) It can curtail the cost of hardware.
- iii) Companies need of physical storage space can be reduced.
- iv) Client has the advantage of processing power of the entire network.
- v) Compute and storage cloud architectures and implementations
- vi) Map-reduce and its generalizations
- vii) Programming models and tools
- viii) Novel data-intensive computing applications
- ix) Data intensive scalable computing
- x) Distributed data intensive computing
- xi) Content distribution systems for large data
- xii) Data management within and across data centers

Applications of Cloud Technologies In Libraries

1. Libraries can host their own websites with the help of cloud technologies. The District of Columbia Public Library is using Amazon's EC2 (Elastic Computing Cloud) service to host their website and it provides libraries with rapid scalability and redundancy.
2. Libraries can build digital library, content management system, institutional repository, Inter Library Loan (ILL) system and Integrated Library System (ILS) from locally-managed to vendor-hosted environment, of their own with the help of cloud technology.
3. Libraries can use cloud technology like Google Docs to store library documents by making one Google account and provide service to the user. It collects responses in web forms, Google Calendar for instruction and meeting rooms, and Google Analytics to collect statistics about their website, catalogue and blogs.
4. Cloud technology can be applied for backing up of media collections and storing and accessing of bibliographic data. Libraries can also store and maintain much of the same data hundreds and thousands of times.
5. Libraries can build their PC system on cloud with this technology so that user can incorporate more simply the system. When the library systems are deployed as open cloud solutions then the library community itself can step up to create extensions to their core services and more importantly share them throughout the community using cloud computing.

Libraries are shifting their services with the attachment of cloud and networking with the facilities to access these services anytime, anywhere. Cloud computing offers many interesting possibilities for libraries that may help to reduce technology cost and increase capacity reliability and performance for some type of automation activities. Clouding computing has large potential for libraries. Libraries may put more content into the cloud computing.

The following possible fields were identified where cloud computing services and applications may be applied in Libraries:

1) Searching Library Data:

Many libraries already have online catalogues and share bibliographic data with OCLC. OCLC is one of the best examples for making use of cloud computing for sharing libraries data. It is offering various services pertain to circulation, cataloguing, acquisition and other library related

services on cloud platform through the web share management system.

2) File Storage:

To access many files on the internet cloud computing present number of services such as Flickr, Drop box, Jungle Disk, Google Doc, Sky Drive etc. These services virtually share the files on the web and provide access to anytime, anywhere without any special software and hardware. Therefore libraries can get advantages of such cloud based services for various purposes. LOCKSS (Lots of copies keeps stuff safe), CLOCKSS (Controlled LOCKSS) and portico tools are extensively used for digital preservation purpose by libraries.

3) Searching Scholarly Content:

Currently, Information and Library Network (INFLIBNET) center has been incorporated Knimbus cloud service into its UGC INFONET DIGITAL Library consortium in order to search and retrieve scholarly contents attached therein. Knimbus is cloud based research platform facilities to search and share the scholarly content. It is dedicated to knowledge discovery and collaborative space for researchers and scholars. Knimbus was started its journey in 2010 by the entrepreneurs Rahul Agarwalla and Tarun Arora to address challenges faced by researchers in searching across and accessing multiple information sources. Knimbus is currently used in over 600 academic institution and R&D labs by scholars, researchers and scientists as well as over 50,000 researchers.

Now Knimbus proposed a free offer to get registered to empower the libraries for dynamic searching and also for single point search interface, maximum the usage of all e-resources, customized search across selected sources reduces noise and highlights relevant content and tools to support the complete research lifecycle.

4) Website Hosting:

This is one of the earliest adoptions of cloud computing as many organizations including libraries preferred to host their websites on third party service providers rather than hosing and maintaining their own service. Google sites serve 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.

5) Community Power:

Cloud computing technology offers great opportunities for libraries to build networks among the library and information science professionals and interested information seekers by using social networking tools. Twitter and Facebook are most famous social networking services which are play a key role in building community power. This cooperative effort of libraries will create time saving, efficiencies and wider recognition, cooperative intelligence for better decision making and provides the platform for innovation and sharing the intellectual conversation ideas and knowledge.

6) Library Automation:

Polaris provides variant cloud based services such as acquisitions, cataloguing, process system, digital content sand provision for inclusion of cutting edge technologies used in libraries for library automation purpose. Also supports various standers such as MARC 21, XML, Z39.50, UNICODE etc. which directly related to library and information science area.

7) Digital Library and Repository:

Today every library needs a digital library to make their resources, information and services at an efficient level to ensure via the network. Therefore, every library is having a digital library that developed by using any digital library software. Dspace and Fedora are used for building digital libraries and repositories. Dura cloud provides complete solutions for developing digital libraries and repositories with standard interface and open source codes for the both software.

IV. CLOUD COMPUTING AT LIBRARIES

The above benefits are mostly applicable to libraries and other small-to-mid-sized organizations. Effective planning and decision regarding implementation is the most important factors for its success.

1. Financial Barriers vs. Cost Savings:

Each library is facing acute shrinkage in budget. Varieties of resources, in all forms (printed and digital) broadened the issue. Purchasing infrastructural facilities recurrently and updating/up gradation of software and hardware is becoming a bothering issue. Cloud computing offers price savings due to economies of scale and the fact that you're only paying for the resources you actually use.

2. Rigidity vs. Flexibility and Innovation:

Risks can be taken for creative and innovative ideas as the new application will run on provider's infrastructure. Libraries don't have to decide about the bandwidth, traffic etc. Creation and configuration of virtual server for storing digital resources would be easier as the script would be run under providers own machine.

3. Cloud OPAC and Cloud ILS:

As of now the libraries are providing Union catalogue services through consortia approach, is still in its infancy. As now more and more LMS vendors are offering cloud-hosted versions of their tools, it is strongly expected that OCLC's cloud based ILS tools that complement their existing cataloging tools (e.g. WorldCat and FirstSearch). Unified search engine and catalogue retrieving tools may help global user to access more information in real time, satisfying the fourth law of LIS.

4. Cloud types and LIS:

There are too much hype and optimism surrounding cloud computing. Lots of gray areas are still there which needs to be addressed promptly for implementation of cloud computing in LIS. Concerns about security, privacy and reliability are the most important among them. To mitigate the fears above the libraries choose to go for hybrid cloud model. This hybrid model would let libraries maintain more control over the applications and data stores that contain sensitive, private information about patrons. Fine tuning and adjustment of resources can also be done quickly.

V. HOW THE TREND OF CLOUD COMPUTING WILL IMPACT LIBRARIES?

Library and information centres are constantly in search of low-cost and best solutions that may enable them to serve the user needs efficiently and effectively. Ironically, with the involvement with IT the commitment as well as services has been miserably infested. Under such conditions, cloud computing is the saviour of all the ebbs of the information technology. Cloud computing is a mega 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 & researchers "Cloud computing has become an attractive option for organizations, like libraries, that would prefer to concentrate more of their focus and funds on their core mission instead of on IT issues" However, implication of cloud computing in libraries has been unresolved area of debate and concern in library profession. Moving from ground to the cloud is surrounded with ambivalence that whether cloud computing offers the best solution to serve the user needs or not. There has been abrupt change in the approaches of library patrons to information accessibility and delivery that have actively moved into the virtual environment. Smart phones, Mobile phones, Tablets and laptops are everywhere now. Libraries as such need to deliver resources and services in the virtual environment preferred by students, researchers, staff and faculty members or they risk alienating users. To keep pace with time libraries need to switch over to cloud and deliver content, tools and services accessible to mobile users via mobile devices. Further, there is a need to "understand better why users prefer internet tools and services such as web search engine, e-mail, blogs, and RSS feeds despite their respect for and trust in the library's resources" in redesigning the services. Although, the development of cloud based libraries is going to take a long time it is inevitable to look at various opportunities on offer from cloud computing that necessitates its adoption.

Advantages of Cloud computing in libraries:

- 1. Cost Efficiency:** Cloud computing is probably the most cost efficient method to use, maintain and upgrade.
- 2. Scalability-** "Pay as you go" allowing a more efficient control of expenditures.
- 3. Lower investment, reduced risk-** Immediate access to the improvements in the resource proposed (hardware and software) and debugging.
- 4.Support included-** Enjoyment of the most advanced security procedures, availability and performance of providers with experience and knowledge in this type of service.
- 5. Greater security and accessibility-** Access to resources from any geographical point and the ability to test and evaluate resources at no cost.
- 6. Portability-** since the service is available over the web, the service can be availed through browser from any part of the world.
- 7. Adjustable storage-** In the traditional system, if the server is less than what we have. The server should be replaced with the new one. In this computing, the storage capacity can be adjusted according to the needs of the library, since the storage is controlled by the service provider.
- 8. Cloud OPAC-** Most of the libraries in the world are having the catalogue over the web. These catalogues are available with their libraries local server made it available over the web. If the catalogue of the libraries made it available through cloud, it will be more benefit to the users to find out the availability of materials.
- 9. Unlimited Storage-** Cloud gives you almost unlimited storage capacity.
- 10. Backup and Recovery -** Most cloud service providers are usually competent enough to handle recovery of information. Hence, this makes the entire process of backup and recovery much simpler than other traditional methods of data storage.
- 11. Essay Access to Information-** Once the users register in the cloud they can access the information from anywhere, where there is an internet connection. services, especially in building digital libraries. Role of LIS professionals in this virtual era is to make cloud based services as a reliable medium

to disseminate library services to their users with ease of use and trustworthiness.

Examples of Cloud libraries:

1. OCLC
2. Library of Congress (LC)
3. Exlibris
4. Polaris
5. Scribd
6. Discovery Service
7. Google Docs / Google Scholar
8. Worldcat
9. Encore

Risk and challenges of cloud computing in libraries:

Cloud Computing suffers from many risks and challenges during the course of its implementation. Like every technological concept, cloud computing is not an exception in terms of trust and security issues. Most of the risks associated with cloud computing are from the customer's point of view as the data is owned, controlled and processed outside of the organization which logically brings a certain amount of risk, because in a sense it is a form of outsourcing. Data processing causes to shift any form of security from the organization to the outsourced organization which mandates the acquaintances with risk procedures beforehand. On the other hand, presumes that within a cloud computing environment what stays important is that most cloud users (clients) are usually not aware of the complete policy and thus do not know very well what risks they are exposed to when entering their data into the cloud. Shen and Tong, 2010 feels that during the course of adoption of cloud computing security is a big concern due to the availability of different systems that may be working in a multiple environment. Additionally, with the proliferation of mobile and personal devices like smartphones and tablets there has been an increase in the cloud based storage services like Google Drive, Dropbox or Microsoft Dropbox which has raised the issues of data privacy, confidentiality putting the user at a legal risk. Once data are outsourced to a third-party cloud provider, several concerns arise about security, availability and reliability of data. While also feel that data integrity, trust, privacy, expectations, control, regulations, intellectual property management, audit trails, service-metering and performance are some of the critical concerns associated with cloud computing. Another issue that are critical implementation of cloud computing which includes technical, legal and organizational policy.

Challenges in the cloud computing arena such as a constant internet connection, slow internet connections, limited features offering, security, danger of data loss. supplement the arguments and claim that the services that libraries can acquire through the use of cloud computing platforms may indeed be valuable, but the cost of internet access, even if bandwidth is not currently at a premium, can become a considerable hurdle to effective provision of services". However, commenting on the challenges associated with cloud computing remarks that the biggest impediment to cloud computing will not be technological but attitudinal. Complexity of an innovation can act as a barrier to implementation of new technology; complexity factor is usually negatively affected.

CONCLUSION

Libraries are moving towards cloud computing technology in present time and taking advantages of cloud based services especially in digital libraries, social networking and information communication. Therefore it is time for libraries

think seriously for libraries services with cloud based technologies and provide reliable and rapid services to their users. Another role of LIS professionals in this virtual era is to make cloud based services as a reliable medium to disseminate library services to their users with ease of use and save the time of users. Cloud computing is an emerging computing paradigm which promises to provide opportunities for delivering a variety of computing services in a way that has not been experienced before Cloud computing which is applied in digital libraries, analyzes current situation and existing problems of the cloud computing in digital library .On this basis, on the combination of cloud computing, SaaS, web2.0, SOA and other technologies. All library resources and service distributed on the Internet can be integrated as a whole, which forms a new type of adaptive control service system supporting interlibrary collaboration and service access, as well sharing resources from different libraries. But in practice, the cloud computing is facing the large number of technical problems and engineering problems. Therefore, it is necessary to encrypt data and make that the data obtained illegally cannot be deciphered. Cloud computing technology is still relatively young in terms of maturity and adoption. The expectation is that it will undergo several changes in the future, in terms of resources, issues, risks, and ultimately best practices and standards. However, there are some sought of great advantages it can potentially provide value for institutions of higher education.

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