

Cloud Computing: A State-of-the-art Computing Environment for Library Services

Dr. Tabasum Maqbool

Librarian, District Institute of Education and Trainings, Ganderbal, Jammu And Kashmir

Email: tabasum.lis@gmail.com

Abstract: Latest technological development has brought a dramatic change in every field, and library science is not exception to it. Information technology impacted positively on library and information system and services they provide for users. The libraries have been automated, networked and now moving towards paper less or virtual libraries. To gather challenges in the profession librarians are also applying different platforms in Library science filed for attaining economy in information handling. This paper overviews the basic concept of newly develop area known as cloud computing. The use of cloud computing in libraries and how cloud computing actually works is illustrated in this communication.

Keywords: Cloud Computing, Libraries, Cloud Services, Cloud Storage,

I. INTRODUCTION

Cloud computing, one of the most exciting developments has become omnipresent among the technocrats and enthusiastic librarians world over as a technology solution as well as resource sharing venture. It is sometimes compared with the virtualization of computing power, applications and storage, thought of as a model to deploy pay-as-you-go web services or perceived to be similar to grid computing and shares characteristics with all of these technology paradigms and more. Cloud computing, the new technology model is the use of computer resources (hardware and software) that are delivered as a service over a network. It is named after the use of cloud - shaped symbol it contains in system diagrams as an abstraction for the complex infrastructure. Cloud computing has been coined as an umbrella term to describe a category of sophisticated on-demand computing services initially offered by commercial providers such as Amazon, Google, and Microsoft. It denotes a model on which a computing infrastructure is viewed as a "cloud," from which businesses and individuals access applications from anywhere in the world on demand. The main principle behind this model is offering computing, storage, and software "as a service."

How is cloud computing different?

For much of the past 25 years, software development and system engineering has centered primarily on the personal computer. The PC era was characterized by monolithic, proprietary operating systems and programs that had long development times and release cycles. In that environment, the design of software was isolated and all attention focused on a single application. With cloud computing, hardware and functionality traditionally installed and run in a local environment is now performed on the network, in the Internet cloud. In essence, the Internet cloud becomes the development platform and the operating system to which programmers

write reusable, constantly updated software components that are delivered over the network and that can be embedded or loosely coupled with other Web applications.

Libraries have been using some cloud computing services for over a decade. Online databases are accessed as cloud applications. Large union catalogs can also be defined as cloud applications. However, a look outside libraries is warranted to better understand the value proposition of cloud computing.



Figure 1

Why are businesses and organizations adopting cloud computing solutions? Jeff Bezos of Amazon has repeatedly spoken of the 70/30 rule. He states that it can be demonstrated that businesses which run applications spend 70% of their time and money supporting the infrastructure required to keep their business going. This only leaves them 30% of time and money to work on innovation and ways to improve and grow their business. He goes on to show that

when a business moves their core applications to a cloud-based solution, they can invert this ratio thus giving them 70% of their time and money to improve and grow their business. In a recent conversation with the director of a large academic research library, this proposition was set forth. She started laughing and said she wished they were only expending 70% of the time and money on infrastructure (Goldner, 2010).

Models

Cloud computing have gone through number of phases. It is a metaphor of internet. Big advantage of computer *Software as a Service (SAAS)*

SAAS is a model where Software Company provides maintenance. Daily technical operations and support for the software provided to client by the vendor. Cloud computing make the availability of s/w as a service to its end user. These services are provided through internet. He will pay only for what he used. In SAAS user will only request of particular software and vendor will provide the services to the user. End neednot to bother about the license and other software related issues.

Platform as a Service (PaaS)

Paas is like a SaaS and it is a delivery model which deliver computing platform as a service over the internet. in essence we can say it is s/w which provides it as service that can be used to build higher-level services. PaaS provides development environment that user can access and utilize on the internet. Services are provided through browser.

Infrastructure as A service (IaaS)

Infrastructure as a Service is a provision model in which an organization outsources the equipment used to support operations, including storage, hardware, servers and networking components. The service provider owns the equipment and is responsible for housing, running and maintaining it. The client typically pays on a per-use basis.



Figure 2

It is sometimes referred as Hardware as a service. It provides basic storage. It provides services on the internet. Examples of IaaS are IaaS, go grid Right scale. Services and software products as on demands computing to the organizations as the other on demand utilities such as electricity, water etc. simply provides latest technologies no software or data but still data

can be retrieved from any where through internet. It is newly emerged method which is broadly used in information technology which has shown new horizons to the knowledge based society.

Types of Computer Clouding

Broadly there are two types of computer clouding

1. Public cloud
2. Private cloud
3. Hybrid cloud
4. Community cloud

Public Cloud: Public cloud sells service to any one on the internet. Amazon is one of the public cloud providers. Customer has no information about the location of the cloud. Infrastructures are shared between organizations.

Private Cloud: It is different from public cloud because it provides data to limited number of people. Private clouds are expensive but it is considered more secure then public clouds.

Hybrid Clouds: This is combination of public and private computers. it has qualities of both public clouding private clouding. In this type of cloud sensitive data is stored in private cloud and other data is in public cloud.

What is Virtual Private Cloud: When service provider uses public cloud resources to create their private cloud. This result is called virtual private cloud.

II. REAL WORLD EXAMPLES OF CURRENT LIBRARY CLOUD SOLUTIONS

To date, the main focus of libraries moving into the cloud has been discovery services, the need to disclose their vast collections on the Web. Though library OPACs attract existing patrons they are not integrated with most information seekers common workflows. So a first step for libraries has been to start massively aggregating data about their collections into common pools. OCLC's WorldCat, the first example of this, is now forty years old and pre-dates both the Web and cloud computing. Other similar union catalogs have existed throughout the world most commonly supported by national libraries and large union catalogs, such as the National Library of Australia, the Bayerische Staatsbibliothek in Germany, and Bibsys in Norway (Goldner, 2010).

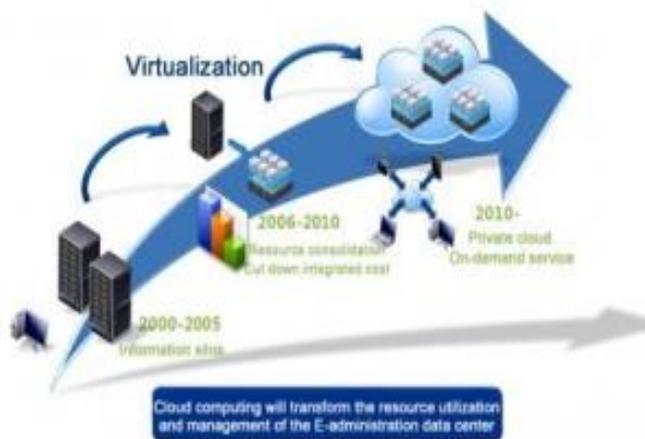


Figure 3

However the advent of the Web has allowed libraries to extend this original vision in new ways.

Extending these services beyond traditional library collections is well illustrated by the National Library of Australia's (NLA) Trove. It has used the Web to accomplish two tasks. This is done by first combining the collections of Australian libraries with other important Australian and international collections and information sources such as Wikipedia and secondly to open much of this content so the public can tag it, edit it, collect it and review it.

The explosion of digitization projects in the last decade has driven this gathering of information in new directions with examples in addition to NLA's Trove to others like the .

III. LITERATURE SEARCH

Literature search is a pre-requisite for reviewing literature on any subject. It attempts to explore pertinent literature through computer or manual searches. Traditionally this is done by scanning some prominent journals and conferences exclusively dedicated to the subject.

However, according to Yang and Tate (2009) focusing on limited outlets cannot be justified for a literature review on cloud computing as this is a recent phenomenon which just emerged two years ago, therefore the publication channels are still largely scattered. For most of the concurrent phenomena Information Science researchers and scholars are using online databases as their first literature collecting strategy.

As the concept is still in its infancy which has not fully ripened so it was difficult to fetch information from the library collections. Efforts were laid to get information from online databases, journals, search engines and repositories. All the Web based references mentioned in this work were retrieved during research period of September 2011 to March 2012. However due to the dynamicity of web they may not be functional now. Efforts have been laid to mention only those web addresses which are likely to work during this work but there are possibility that some links may not work. Moreover, it is almost impossible to review all the literature available on a concerned subject. Impediments like language, accessibility, time and proficiency keeps a check on it. In spite of these, attempts have been undertaken to review literature relevant to present study. Some of the scholars have attempted to trace the roots of Cloud Computing from business.

Inspired by similar thoughts Low, Chen and Wu, (2011) opines that "as we could expect, the term cloud is derived from the idea of businesses and users being able to access applications from anywhere in the world on demand". According to Low, Chinyao, Chen, Ychsueh and Wu, Mingchang (2011) Cloud computing provides the opportunity of flexibility and adaptability to attract the market on demand. However, Geelan, (2009) argues that "Cloud computing is the infrastructural paradigm shift that is sweeping across the Enterprise IT world that has as many definitions as there are squares on a chess-board". " Under such circumstances there is a general agreement of scholars like Buyya et al. (2009); Pyke (2009) that "cloud computing services can provide the user seamlessly, the convenience, and the quality-stable technological support that can develop the enormous potential demand". In nutshell, Cloud computing is also, defined as a

collection of disembodied services accessible from anywhere using any mobile device with an internet-based connection. Erdogmus, (2009); "Cloud computing has spread out through the main areas related to information systems and technologies, such as operating systems, application software, and technological solutions for firms" Armbrust et al., (2010) (p. 55). His arguments are supplemented by Hand (2007) who argues that "in cloud computing not just our data but even our software resides within the cloud, and we access everything not only through our PCs but also cloud friendly devices, such as smart phones, PDAs, the mega-computer enabled by virtualization and software as a service".

IV. USE OF CLOUD COMPUTING IN LIBRARY AND INFORMATION SCIENCE

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.



Figure 4

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

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 Brindaa (2012).

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.

V. POTENTIAL AREAS OF CLOUD COMPUTING APPLICATION IN LIBRARIES

The various ranges of services that can be offered via the Cloud computing enabled libraries are enlisted below:

- **Automation:** Till day, automation in libraries are being undertaken on locally hosted servers using different types of commercial and open source integrated library management software and managed by either internal IT or library staff. Now many of the software vendors and third party services offering of this service on the cloud to save libraries for investing on hardware. Also the library will free from undertaking maintenance such as software updates, back up etc. For Example: Wx-libris.
- **Building Digital Library/Repositories:** In the present situation, every library needs a digital library to make their resources, information and services at an efficient level to ensure access via the network. Therefore, every library is having a digital library that developed by using any digital library software. Using of locally hosted open source software such as DSpace, E-prints, Fedora to provide free access to scholarly resources. Not only adding resources but also in server maintenance, undertaking back up and regular updates and a lot of pressure on library or IT staff when new version of the software get released. Now many vendors are offering digital library

services on the cloud using SaaS approach to relieve the libraries from such pressure. Example: Duraspace cloud, OSS Lab.

- **Website Hosting:** A very common arrangement involves simply hosting a website. Simple web-hosting arrangements allow the provider to aggregate a number of customer sites onto server hardware. Web hosting allows an organization to avoid server management and internet connectivity issues and to focus on the content of the site. Technically complex websites that involve scripting with PHP or Perl, content management systems, and other plug-in many require other arrangements beyond simple web-hosting services.
- **File Storage:** To access any files on the internet, cloud computing present number of services such as Flickr, Dropbox, Jungle Disk, Google Doc, Sky Drive and so on. These services virtually share the files on the web and provide access to anywhere and anytime without any special software and hardware. Therefore, libraries can get advantages of such cloud services for various purposes.
- **Dedicated Hosting Services:** Similar to co-location, a library can opt for hosting services through its data center or a commercial provider. Most hosting services involve leasing equipment from the provider. This saves the library the cost of acquisition in exchange for monthly or annual subscription costs. When starting up a hosting arrangement, the library will detail the specifications of the server required, including processor type, amount of memory, disk storage, and the desired operating system. The provider will then allocate a server that meets these specifications and turn it over to the library to install the software.
- **Software as a Service:** Software as a service, or SaaS, has emerged as a major model for the deployment of business and consumer software. Many library automation vendors favour this approach and market it aggressively. This model delivers access to a software application independently of hardware considerations. The SaaS provider many take advantage of virtualizations. The SaaS provider many take advantage of virtualization, server clustering and other efficiencies in order to deliver an instance of its software in the most efficient way, yet it can deliver the software in a way that functions as if the library operated it locally. In a SaaS arrangement, the user can configure the software as needed but cannot customize it at the level of changing functionality. SaaS usually involves the provider taking responsibility for the implementation of all software updates and the myriad other behind-the-scenes technical details. While SaaS work especially well with entirely web-based applications, it also support applications that involved desktop clients.
- **Scholarly Content Searching :** Cloud computing technology offers great opportunities for libraries

to build network among the library and information science professionals as well as other interested people information seekers by using social networking tools. The most famous social networking services viz. Twitter and Facebook which 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 conversations, ideas and knowledge.

- **Virtualization:** Today's advanced computer hardware far outpaces the needs of many software applications. A dedicated server running a typical applications load many operate at less than 10% of processing capacity and memory. Virtualization, a technique that less than 10% of processing capacity and memory. Virtualization, a technique that has gained extremely wide acceptance, involves allowing multiple instance of operating systems to share a single physical server. These may be multiple instances of the same operating system or of different ones. This approach allows end users to simultaneously run multiple desktop systems such as Microsoft Windows, Linux and Mac OS X. In the data center, virtualization allows each physical server to operate near its capacity reducing the number of devices needed overall as well as the devices, physical footprint, energy consumption and technical management. Since each instance of a virtual services functions independently as if it were on dedicated hardware, each can serve different clients and their complement of applications. Unfortunately, not all applications run well in a virtualized environment. The technical programming of some applications may monopolize resources in way that disrupt virtual environments. Organizations need to test their critical applications in a virtual machine prior to production deployment. Virtualization can be implemented in locally managed, co-located, or remote-hosting scenarios. It requires careful administration to ensure a reasonable balance of virtual machines per physical devices and to monitor the resource use of each instance.

VI. PROBLEMS OF DIGITAL LIBRARY

Digital library for our study provides an appropriate, along with the increasing knowledge level, the requirement of digital library and increasing because of uneven economic development in different regions causes the digital library's resources to be comparatively short, to university digital library as an example. Various colleges and universities while are raising the respective teaching level unceasingly, have established a digital library to purchase its own database resources, but because of the teaching focus and economic conditions, library resources between university's has the differences, meanwhile looked from the whole that the Digital library has certain flaw. Data resources between various universities are relatively independent, building redundant projects possibility was high, has created the manpower, the

financial resource and the resources waste, or some colleges and universities to use only part of database resources, inadequate use of resources, and cannot play resources maximum utilization. Digital library representative one kind of new infrastructure and the environment, through the cloud computing, it may use resources more effective, and can solve the defects of digital library.

a) Cloud computing awareness

Based on cloud computing in the cost design, presentation, team collaboration and the returns of the physical location, because parallel the different application process has used the different mutually self-sufficient platform, each application procedure finalizes on own server. Using cloud computing we can share the server in many application procedures, appreciates the resource sharing, thus also reduced server's quantity, achieves the effect of reducing the cost, therefore utilizes cloud computing in the Digital library, will give our work, the life and the study inevitably gains a greater efficiency.

VII. CONCLUSION

We know that library is not only a knowledge ocean, its ultimate aim is to provide satisfactory services for all the people. So in the new era, library should improve itself constantly by adopting many new IT technologies. And in this paper, we attempted to improve current user service model in university library by using Cloud Computing. Although study of Cloud Computing is still in the initial stage now, impacts brought by Cloud Computing are obvious. With the introduction of Cloud Computing to university library, services of libraries will have a new leap in the near future. Services provided by libraries will become more user-centric, more professional and more effective, etc. And we all believe that libraries will create more knowledge benefits for our country with the help of Cloud Computing. Cloud environment is a highly developed network environment; it appears to the users of high-quality service and high security. The Cloud computing techniques and methods applied to digital libraries, not only can improve the utilization rate of resources to address the imbalance in development between regions, but also can make more extensive use of cloud computing to our work life.

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