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Cloud Libraries: A Novel Application of Cloud Computing

Faiz Abidi*, Hasan Jamal Abidi**
* Department of Computer Engineering, Jamia Millia Islamia University
** Central Library, Jamia Millia Islamia University

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ABSTRACT

Libraries all over the world suffer from common problems like flexibility associated with the digital data, lower levels of efficiency, and huge cost involved in managing the entire IT infrastructure themselves. Few options are available when it comes to collaborating with other libraries as well which is the prime reason for subordinate levels of efficiency. Cloud computing would help us in bridging the gap between digital libraries and IT. Sharing of data among the libraries will in principle reduce the overall cost and increase the efficiency. Capital expenditure done on infrastructure will chiefly be converted into operational expenditure. It will also enhance the users' experience and will help in making the libraries a lot more scalable.

Corresponding Author:

Faiz Abidi,
Department of Computer Engineering,
Jamia Millia Islamia University,
Jamia Nagar, Okhla, New Delhi 110025, Delhi, India.
Email: faizabidi@ieee.org

1. INTRODUCTION

In 1943, Thomas Watson, the then chairman of IBM, famously said, "I think there is a world market for maybe five computers". As time passed, path breaking technologies came into being which completely changed the way people looked at personal computers. In 1960, John McCarthy, a computer scientist, noted that "computation may someday be organized as a public utility". It is here that the foundation of cloud computing was laid.

But, it was only in 2007 that big companies like Google, IBM etc started extensive research on cloud computing and its possible benefits on the IT industry. Since then, a lot has been said and debated upon in respect to cloud computing. However, in spite of the hype that surrounds cloud computing, not many, still, are familiar with its concept. Cloud computing is often proposed as the biggest revolution since the internet. Users who have had the experience of using Web 2.0 services like Wikipedia, Blogger, and Flickr etc have already experienced 'cloud computing', maybe unknowingly. Let us first briefly explain cloud computing and then discuss what it holds in store for the libraries. Cloud computing can interchangeably be called location independent computing. A user can access all that s/he owns anywhere on the planet by just logging onto the World Wide Web. Resources will be shared among users and hence the cost factor will automatically go down. A user will be required to pay for exactly the amount of resources s/he consumes and will be billed on a monthly/yearly subscription basis.

The basic idea behind cloud computing is economies of scale. No longer will the CPU's remain in idle state and memory unused. Another fascinating concept of cloud computing is its scalability. A user can, at any given point of time, ask for an increase or decrease of resources/infrastructure in the cloud. This particular option of scaling up or down the resources depending upon the need will directly help the organizations in cutting down the capital cost and converting it into operational cost. An organization will no longer be required to predict its future needs.

The growth of a university library is directly proportional to the amount of funds it has. However, with the lack of integration among libraries combined with the soaring cost of resources, the librarians are finding themselves in a predicament. Some of the basic issues pertaining to the library management system can be resolved, with some satisfaction, if cloud computing is incorporated into our libraries.

The very fact that one has to pay for only operational cost without worrying about any upfront cost, boasts a very exciting scenario for the libraries. Cloud computing just provides the perfect solution which the libraries all around the world were craving for.

2. INTEGRATION AMONG LIBRARIES

Libraries are finding it difficult to keep pace with the ever growing need of enhanced and better forms of information. Ever year, thousands of books are bought by the libraries in order to keep track with the latest available literature on different subjects. Obviously, with their fixed budgets, not all books (or eBooks) can be purchased. Every library tends to have certain data which may be present in some other libraries too which leads to a lot of duplication of data. However, if the libraries integrate their data, there would be no more duplication since the libraries would be sharing the common data. The implementation of this technique, though, may not be as simple as it may seem to be. It is here that cloud computing can play its part.

Cloud computing can help libraries collaborate with each other in a facile manner. Every library has its own electronic data resources. If the all the electronic data resources are put together in a single place which may be accessed by a group of libraries, the whole electronic data base will become huge. This space which contains all the electronic data can be some cloud, say, a library cloud. This library cloud will contain the digitized data of different libraries and hence, will help libraries integrate their data. The need for maintaining and backing up the data will be no more the responsibility of the libraries since all the data will be stored in the cloud which shall be managed by some cloud provider.

It will also help the libraries in scaling up or down their data capacity whenever required. This scaling up or down is purely a function of need. Hence, the libraries would be consuming exactly the required space. Not a megabyte more! As a result, libraries will not have to predict their future needs and buy space and infrastructure beforehand. This co adjuvant effort of the libraries will not only increase the overall efficiency (since the data will be shared) but also open doors for innovation, make libraries a lot more scalable and help save money as well.

HathiTrust[3] is a great example which shows us what cloud computing holds in store for the libraries. HaithiTrust is a repository for keeping huge amount of digitized data being shared among its members. It was founded in October 2008 and already has over sixty partners mostly including university libraries all around the world.

3. DEPRECIATING THE LIBRARY BUDGET

By embracing the cloud, libraries will find the capital expenditure done on infrastructure being converted into operational expenditure (Fig.1). They will be paying for exactly the amount of resources being consumed by them i.e. *pay for what you use* system.

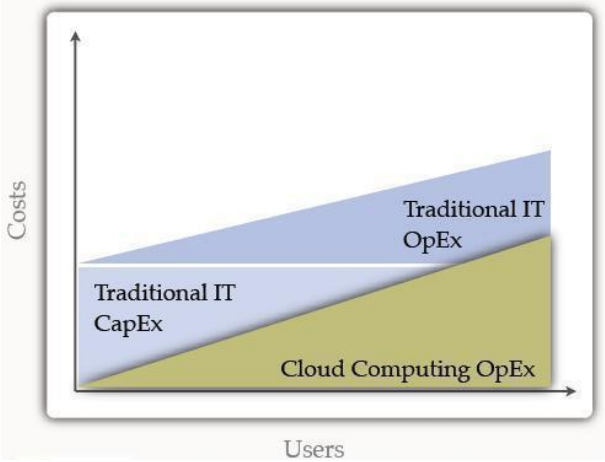


Figure 1. Cloud computing economics

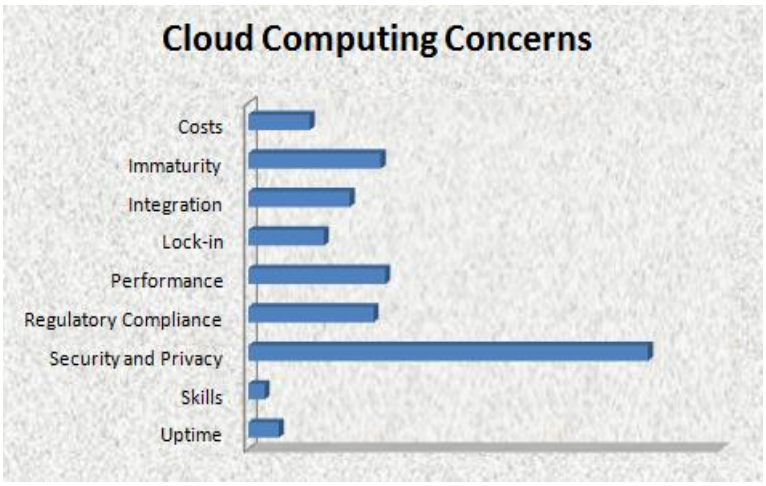
There will be no servers installed locally since all the required servers will be hired on some monthly/yearly subscription basis from any cloud service provider. Server maintenance and replacement and other IT related work will solely be the responsibility of the organization proving cloud based solutions and thus a lot of library staff will be freed. Jeff Bezos[2] of Amazon has often spoken about the 70/30 rule. He states that organizations spend 30% of their time and money building a product or service and spend 70% of their time and money managing and supporting the infrastructure etc. Cloud computing can help reverse this equation into a 30/70 rule. The induction of cloud computing into libraries will free up staff and hence the staff can devote more energy and time in collection building and improved services. Innovation is also expected to be increased since testing of any new idea will be done on someone else's infrastructure and thus, reducing the risk factor.

The scalability option which comes along with cloud computing would also help libraries save money. Traditionally, libraries have to so design their website which can handle peak traffic occurring only a few times in a month. In doing so, the libraries have to buy more servers. However, with servers in the cloud, the libraries will be paying for exactly the amount of server resources being consumed by them. Thus, they will be able to manage peak traffic in an economical way.

It has been noted that libraries depend on some external agency for managing all their servers and other IT needs. However, the money spent on such agencies will be saved if all the servers are in the cloud. The libraries will be paying for only the operational expenditure which will significantly lead to the reduction of library budgets.

4. SECURITY AND PRIVACY ISUUES

In spite of the offerings that cloud computing promises to the libraries, critics claim that new security and privacy issues shall arise by inducting cloud computing into the libraries (Fig.2). The critics also claim that trust factor is also a major concern. Questions regarding data extraction schemes also persist along with the scenario in which a cloud service providing organization goes out of business. However, all the scepticism about cloud computing isn't holding back the librarians from familiarizing themselves about it and its impact on their libraries.



Source: Gartner Survey Results

Figure 1. Major Concerns

As per a survey[3] done in March 2011 in which more than 300 librarians responded, 35% of the librarians consider data security as their main concern for using cloud based services. Long term stability of the service provider was the main concern of 31%. Privacy was the prime concern of 13% whereas data ownership was the concern of 7%.

However, there are a number of solutions already available which address a few concerns quite satisfactorily. SLA's or service level agreements are provided by almost all the cloud service providers which address most of the data concerns and security apprehensions of an organization quite adequately. Amazon has even gone one step further by providing its users the option of private connectivity between cloud servers

and the concerned organization's network. Organizations may also send confidential data in encrypted form to the cloud storage.

In spite of all this, an organization must ensure what kind of SLA's are being provided by the concerned cloud service provider before deciding to choose any. The organization must also be made fully aware about the whereabouts of the servers.

All said and done, when all the data is stored at a single place, the data automatically becomes safer and more reliable. Better security measures can be adopted to make sure that the data is never compromised and its integrity is always maintained. Also, usually, the data is stored at more than one place in the cloud and thus failure of one server will not cause the whole system to crash. Data can always be retrieved easily and efficiently from other servers in case one server fails.

As per another survey[6] which included 72 academic, public, and special libraries predominantly in USA, Canada, Australia, and the UK, 66.67% of the libraries agree that data and file losses may be possible with cloud computing services, these losses will be no worse than that already occurring with traditional storage systems. 2.82% of the libraries are considering using cloud services provided by Rackspace in future, including 5.56% of public libraries and 2.44% of academic libraries. Another astonishing fact which came up in the survey was that as many as 15.38% of libraries with budgets between $750,000 and $5,000,000 use server space rented from cloud computing services. Major cloud computing services have been used for hosting and/or distributing special collections by 2.82% of libraries in the sample. The above surveys clearly show that, slowly but surely, the libraries are realizing the potential of cloud computing. There are a few concerns but they will eventually be meted out with a satisfied solution.

5. GREEN LIBRARIES

With the demand for digital information increasing exponentially every year, more and more servers are also needed to sustain the same. Simply put, more servers not only mean more expenditure, it also means more carbon emission. Keeping this in mind, cloud computing may just provide the solution to the libraries which could make them a lot greener. Typically, libraries tend to have more servers than needed in order to manage the fluctuating demand for digital information. As a result, server's actual potential is never tested. Servers may sometimes even remain in the idle state and being in the idle state doesn't mean any reduction in the carbon emissions. However, cloud computing can help reduce this 'over provisioning' of resources which will directly result in cutting down the overall number of servers deployed. Servers in the cloud will always have large number of operations to perform since they would be shared among the libraries and which would eventually result in utilizing the server's full potential.

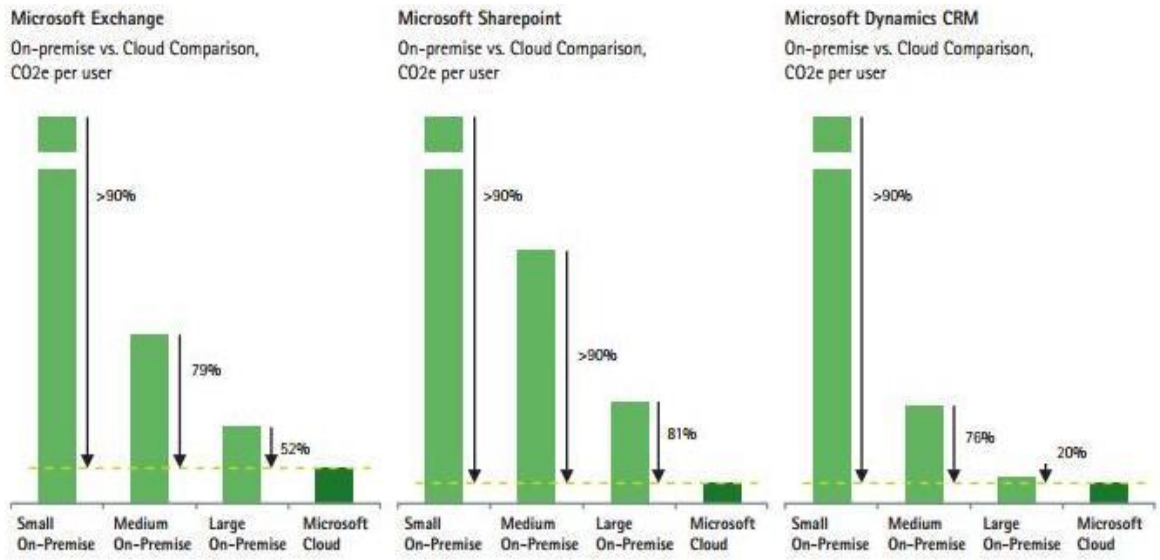


Figure 1. Comparisons of Carbon Emissions of Cloud-Based vs. On-Premise Delivery of Three Microsoft Applications[7]

Multi tenancy is another factor which will help in cutting down the overall carbon emissions. Server utilization along with data centre efficiency will also increase. In a study[7], jointly done by Accenture, Microsoft, and WSP Environment and Energy, it was reported that small scale organizations (100 users) with applications deployed in the cloud can reduce energy consumption and emission by more than 90 percent. It was 60-90 percent for a company having a thousand users. For a large scale company (10k users), the same was reported between 30-60 percent. In the same report it was found that upon using three applications of Microsoft in the cloud, we can significantly reduce CO_2 emissions per user significantly (Fig. 3). Another report issued by the Carbon Disclosure Project 2011[8] estimates that by 2020, large US companies that will be using cloud computing for various IT purposes could end up saving $12.3 billion and carbon reductions equivalent to 200 million barrels of oil annually. Server utilization will increase along with data centre efficiency which will again result in making the libraries green.

6. CONCLUSION

Cloud computing will help the integration of libraries in a painless easy manner. Libraries will be able to share their electronic data resources which shall lead to reduction of duplicate data resulting in cutting down the overall budget of libraries. The dependency of libraries on external agencies for matters pertaining IT is also expected to reduce considerably. Capital expenditure on hardware resources will be converted to operational expenditure. Scalability of cloud computing will also help in saving money. Libraries will also become greener by embracing the cloud. Server utilization, which will increase considerably, along with multi-tenancy, will help reduce carbon emissions annually.

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BIOGRAPHY OF AUTHORS

Faiz Abidi is a final year student at Jamia Millia Islamia University, Computer Engineering Department. He has undergone internships at a couple of companies and his research interests include Cloud Computing, Network Security, Software Development, Wireless Networking and Digital Libraries. His previous work dealt with the effects of cloud computing on healthcare, robotics and piracy which was presented at World Congress on Sustainable Technologies held in London, 2011.

Dr. H.J. Abidi, M.A., M.Lib.Sc., Ph.D., is a Deputy Librarian at Dr. Zakir Husain Library, Jamia Millia Islamia University, New Delhi. He also teaches in the Department of Library & Information Science at the University. Besides various aspects of librarianship, Dr. Abidi has a keen interest in Islam and Indian Muslims and is engaged in active research and study. His previous wok was on "Significance of E-books & digitalization of libraries in the 21st century" which was presented at QQML, 2011 held in Athens.