ROLE OF CLOUD COMPUTING IN MODERN LIBRARIES: A CRITICAL APPRAISAL

Kanchan Kamila*

Abstract *The first scholarly use of the term "cloud computing" was in 1997 by Ramnath Chellappa though the concept originated in 1960s. Cloud computing is a new concept of computer and information science especially in IT services industry which can be termed as third revolution after Personal Computers and Internet. In cloud, the information is stored on the internet and distributed via network at any large network environment. The main concern is data sending, receiving, storing and dissemination of data whenever required by the users. The hardware and software are integral parts of cloud computing, without these we can't imagine services provided by cloud environment. This paper also discusses about the characteristics, types, layers, merits and demerits of cloud computing, adopting cloud computing and impact of cloud computing in libraries and concludes that the cloud computing model will encourage libraries and their users to participate in a network and community of libraries by enabling them to reuse information and socialize around information. It can also create a powerful, unified presence for libraries on the Web and give users a local, group and global reach.*

Keyword: *Service Based Cloud Computing, Usage Based Cloud Computing, Layers of Cloud Computing, OCLC, WorldCat*

BACKGROUND HISTORY

The underlying concept of cloud computing dates back to the 1960s, when John McCarthy opined that "computation may somebody be organized as a public utility". Almost all the modern day characteristics of cloud computing have been thoroughly explored in Douglas Parkhill's 1966 book, *The Challenge of the Computer Utility*.

The actual term "cloud" borrows from telephony in that telecommunications companies, who until the 1960s primarily offered dedicated point-to-point data circuits, began offering Virtual Private Network (VPN) services. The cloud symbol was used to denote the demarcation point between that which was the responsibility of the provider from that of the user. Cloud computing extends this boundary to cover servers as well as network infrastructure. The first scholarly use of the term "cloud computing" was in a 1997 lecture by Ramnath Chellappa on *Intermediaries in Cloud-Computing*[11], presented at the INFORMS meeting in Dallas in 1997.

Amazon played a key role in the development of cloud computing by modernizing their data centers after the dot-com bubble, which, like most computer networks, were using as little as 10% of their capacity at any one time and launched Amazon Web Service (AWS) on a utility computing basis in 2006.

In 2007, Google, IBM and a number of universities embarked on a large scale cloud computing research projects. In early 2008, Eucalyptus became the first open source AWS API (Amazon Web Service Applications Programming Interface) compatible platform for deploying private clouds. By mid 2008, Gartner[12] saw an opportunity for cloud computing to shape the relationship among consumers of IT services, those who use IT services and those who sell them and observed that organizations are switching from company-owned hardware and software assets to per-use service-based models so that the projected shift to cloud computing would result in dramatic growth in IT products in some areas and significant reductions in other areas.

In March 2010, Microsoft's CEO, Steve Ballmer, made his strongest statement of betting the company's future in the cloud by proclaiming, "For the cloud, we're all in" and further stating, "About 75 percent our folks are doing entirely cloud based or entirely cloud inspired; a year from now that will be 90 percent".

INTRODUCTION

Cloud computing is a new concept of computer and information science especially in IT services industry which can be termed as third revolution after Personal Computers and Internet, and it delivers applications with the help of internet, access from a web browser, while the business software and data are stored on servers at a remote location. It is the delivery of computing as a service rather than a product, where by shared resource; software and information are provided to their clientele by devices as utility via network and a new way of storing the information. In cloud, the information is stored on the internet and distributed via network at any large network environment. The main concern is data sending, receiving, storing and

* University Librarian, The University of Burdwan, Golapbag, Burdwan – 713104, W.B., INDIA

dissemination of data whenever required by the users. The hardware and software are integral parts of cloud computing, without these we can't imagine services provided by cloud environment. The cloud computing gives an opportunity to use more than one service from more than one location and cloud environment we can use multiple resources from multiple location via multiple network for multiple users. Cloud computing can cut operational price as well as capital costs in IT. The beauty of cloud computing is that the applications are hosted by another company which means that they handle the cost of services, software updating and you pay for the services as per the contact. Cloud computing provide a new delivery model for IT services, the services based on Internet protocols and it is virtual and scalable. It provides computing through remote computer via web sites and on the Internet. It may be a new form of web based tools or application which is used and accessed by their users or clientele with the help of web browser, but it is essentials, these programs were installed locally or remotely on their personal computers.

DEFINITION

Sanchati and Kulkarni (2011) interpreted "cloud computing is the improvement of distributed computing, parallel computing, grid computing and distributed databases".

According to Kroski (2009) "cloud computing is a way to use off-site computer processing power to replace content creation and servers that were traditionally hosted onsite. It does not own the physical infrastructure rather they get it on rent from a third party provider. Simply, cloud computing is using web services for computing needs".

Burford (2010) defined "cloud computing is a computing model, where, customers plug into the cloud to access information technology (IT) resources which are priced and provided on-demand. Essentially, IT resources are rented and shared among multiple tenants much as office space, apartments, or storage spaces are used by tenants".

According to Hua (2010) "cloud computing is a paradigm shift whereby details are abstracted from the users who no longer have need of, expertise in, or control over the technology infrastructure "in the cloud" that supports them. Cloud computing describes a new supplement, consumption and delivery model for IT services based on the Internet, and it typically involves the provision of dynamically scalable and often virtualized resources as a service over the Internet.

Pandya (2012) defined "cloud computing…uses the web (Internet) and central remote servers to maintain data, software and application. Cloud computing allows users to use application without installation in their local machine to access their personal and official files on any computer with internet access".

Simply putting, cloud computing is the outsourcing of IT infrastructure via the Internet, which provides computing resources, such as – processor compute time and data storage, on demand via a service provider rather than maintaining your own hardware and software environment.

CHARACTERISTICS

- Cloud computing isn't just for computers; it's all around this. Suppose you have a PC, Mac and a phone. It would be a pain to manually keep track of data across all three so Apple introduced a service called Mobile. When you update a contact on your phone, the contact is silently synced across all devices. His goes for everything, including pictures and documents.
- In addition, the platform provides on demand services that are always on anywhere, anytime and any place.
- Pay for use and as needed, elastic (scale up and down in capacity and functionalities).
- The hardware and software services are available to the general public, enterprises, corporations and business markets.
- On demand provision for shared resources, software, and information.
- "cloud" is used as a metaphor for the Internet
- Used in past to represent the telephone online
- Typical cloud vendors deliver common business applications network
- Later to depict the Internet in computer network diagrams
- Abstraction of the underlying infrastructure it represents
- Customers do not own the physical infrastructure
- Avoid capital expenditure
- Renting usage from a third-party provider
- Consume resources as a service and pay only for resources that they use.
- Multi-tenancy
  - Centralization Peak load capacity
  - Utilization & Efficiency
  - Agility
  - Reliability
  - Security
  - Maintenance
  - Scalability
  - Cost

However, the main characteristics are discussed below:

On-demand self-service: A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

Broad network access: Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g. mobile phones, laptops, and PDAs).

Resource pooling: The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, network bandwidth, and virtual machines.

Rapid elasticity: Capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.

Measured Service: Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported providing transparency for both the provider and consumer of the utilized service.

Generally, cloud computing customers do not own the physical infrastructure, instead avoiding capital expenditure by renting usage from a third party provider. They consume resources as a service and pay only for resources that they use. Many cloud-computing offerings employ the utility computing model, which is analogous to how traditional utility services (such as electricity) are consumed, whereas others bill on a subscription basis. Sharing perishable and intangible computing power among multiple tenants can improve utilization rates, as servers are not unnecessarily left idle (which can reduce cost significantly while increasing the speed of application development). A side-effect of this approach is that overall computer usage rises dramatically, as customers do not have to engineer for peak load limits. In addition, increased high-speed bandwidth makes it possible to receive the same. The cloud is becoming increasingly associated with small and medium enterprises (SMEs) as in many cases they cannot justify or afford the large capital expenditure of traditional IT. SMEs also typically have less existing infrastructure, less bureaucracy, more flexibility, and smaller capital budgets for purchasing in-house technology. Similarly, SMEs in emerging markets are typically unburdened by established legacy infrastructures, thus reducing the complexity of deploying cloud solutions.

Types of Cloud Computing

Cloud computing can be variously classified but, more popularly on two bases – as under:

- On the basis of services – SaaS, PaaS, and IaaS.
- On the basis of usage – Public, Private, Community, and Hybrid

On the Basis of Services

Software as a Service (SaaS): In this application; software is given as service to users, who can access the required programmes online. Examples include – LibGuides, Salesforce.com, Google's Gmail and Apps, instant messaging from AOL, Yahoo and Google, and VoIP from Vonage and Skype.

Platform as a Service (PaaS): To run required service; a special platform or application infrastructure is also being provided to the clients where clients can build their web based applications. Client does not require knowing programming language, database management systems, etc. to run applications. Well known providers include -Windows Azure, Salesforce.com, Google Maps/Google App Engine, ADP Payroll processing, and US Postal service offerings.

Infrastructure as a Service (IaaS): In IaaS; clients are being offered with storage, networking and processing of data. Vendors may include – Amazon.com for Elastic Compute Cloud (EC2) or Simple Storage Service (S3), VMW, vCloud, IBM and other traditional vendors.

Other cloud providers include Apple, Cisco, Citrix, Joyent, and Verizon/Terremark etc.

On the Basis of Usage

Public cloud: Public cloud or external cloud describes cloud computing in the traditional main stream sense, whereby resources are dynamically provisioned on a fine-grained, self-service basis over the Internet, via web applications/ web services, from an off-site third-party provider who bills on a fine grained utility computing basis.

Private cloud: Some vendors have used the term to describe offerings that emulate cloud computing on private networks. These (typically virtualization automation) products offer the ability to host applications or virtual machines in a company's own set of hosts. These provide the benefits of utility computing-shared hardware costs, the ability to

recover from failure, and the ability to scale up or down depending upon demand. Private clouds have attracted criticism because users still have to buy, build, and manage them and thus do not benefit from lower up-front capital costs and less hands-on management, essentially lacking the economic model that makes cloud computing such an intriguing concept.

Community cloud: A community cloud may be established where several organizations have similar requirements and seek to share infrastructure so as to realize some of the benefits of cloud computing. With the costs spread over fewer users than a public cloud, this option is more expensive but may offer a higher level of privacy, security and/or policy compliance.

Hybrid cloud: The term Hybrid Cloud has been used to mean either two separate clouds joined together (public, private, internal or external), or a combination of virtualized cloud server instances used together with real physical hardware. The most correct definition of the term Hybrid Cloud is probably the use of physical hardware and virtualized cloud server instances together to provide a single common service.

Besides the types (on the basis of services and usage), there is third category of classification of clouding based on applications (Goldner and Pace, 2011), which are software applications accessed with a Web browser. They can further be of following types:

- Google Docs
- Microsoft 365

But first two classifications are most popular and generally they are considered in defining the types of clouding.

Layers of Cloud Computing

There are some important layers of cloud computing which are as follows:

- **Client:** Ready to use services accessed with a Web Browser (e.g., ADP)
- **Application:** Software applications accessed with a web browser (e.g., Salesforce.com)
- **Platform:** An existing software platform to build your own applications on (e.g., Face book)
- **Infrastructure:** Buying space/time on external servers (e.g., Amazon A3 Bungee)
- **Server**

Merits and Demerits

In spite of using cutting edge technologies in cloud computing, still we are in debate of its use in our official systems. Therefore, following pros and cons have been observed.

Merits of Cloud Computing

- **24x7 data accessibility:** All time data accessibility
- **Reduce operational cost**: Technical problems related to storage and accessibility can be taken care of by the service providers. Cloud computing makes free IT resources from infrastructure administration
- **Reduce capital expense**: No need of procuring high capacity storage server and less upfront hardware cost come in clouding
- **No update needed (From Users side):** User does not have to download and install any update on his/her desktop
- **No expertise needed (From Users side):** User does not have to be master of the applications used in cloud computing
- **Improved security:** Clouding makes you worry free
- **Pay per use:** No extra investment is needed
- **Faster time to value:** Rapid development and instant deployment is possible
- **Improve resource productivity:** They build more applications, more quickly, and free up developers for new projects
- **Reduce integration cost:** Every new application builds on the platform is designed for easy web services integration

Demerits of Cloud Computing

- **Problem in privacy and security maintenance:** Privacy and security of data is the major concern
- **Dependency on high bandwidth:** Need high capacity internet bandwidth while accessing subscribed services
- **Loss of control:** The problem of someone else hosting hardware, software and data remain there because all the work is online. So you can lose control on your information or data
- **Uncertainty over loss of stored data:** What happened when stored data get lost?
- **Setting up of Standards:** In order to use the clouds in many cases, one need to be compliant with set standards and established procedures and obtain compliance with regulations
- **Unpredictable cost:** Pay as you go means that the cost of computing will be different every month

Adopting Cloud Computing in Libraries

- **OCLC:** Online Computer Library Center has been functioning as a cloud computing vendor. The OCLC provide cataloguing tools on the Internet and allow member institutions to draw on their centralized data store. The centralized database allows the sharing of catalogue records between libraries and reduces the time for cataloguing. It is a non-profit, membership, computerized library service and research organization dedicated to the public purposes of furthering access to the world's information and reducing the rate of rise of library cost.
- **WorldCat:** Another example of cloud computing architecture drawing on the union catalogue infrastructure they have built up over the years.
- **LibraryThing:** It is one of the sites that combine aspects of social networking and cloud computing is LibraryThing, originated by Tim Spalding. LibraryThing offers services which are just like social networking site, authorizes people to contribute information and suggestion about books and allows them to interconnect globally to share interest.
- **Reed Elsevier:** Reed Elsevier is a service provider for scientific information working with hospitals to provide point in time information to medical technicians as they need the information.
- **Amazon and Google:** These are among the leading enterprises also providing solutions for libraries by having partnership between library automation vendors.
- **Kindle and Mobile Me services:** In the electronic book arena Amazon is providing some reading services with "Kindle". If one have wireless connection, can purchase and read a rapidly growing list of books and periodicals from the Kindle, no matter for the location. With this service largest text can be downloaded in seconds. Another like service is "Mobile Me" provided by Apple computing.
- **SeerSuite:** SeerSuite was developed as a result of extensive research and development with the goal of enabling efficient dissemination of scientific information and literature. SeerSuite refers to a collection of open source tools that provide the underlying application software for creating academic search engines and digital libraries such as CiteSeerX, etc. (Teregowda et.al[9]., 2010)
- **DuraCloud-Duraspace**: A hosted service and open technology to help organizations and end users effectively utilize public cloud services. Built upon existing cloud services. It is providing cloud solution for digital library services. DuraCloud is a sister concern of Duraspace which is a collaboration of the DSpace Digital Library Software and Fedora Commons. Fedora Commons is a framework for digital repository, which offers complete solution for digital library with standard software and hardware solution. DuraCloud also provides open source code and the code needs to be installed on your machine. But if you want to use Dura Cloud Storage and software you have to subscribe DuraCloud services with a nominal cost. The service can work on Amazon, Atmos, Sun, Rackspace, and other cloud services. LOCKSS in the cloud based on DuraCloud (http://surferblue.wordpress.com).
- **Chronopolis Project**: Designed primarily as a preservation storage system. Chronopolis Tools also monitors files and does auditing (http://surferblue.wordpress.com).
- **TerraPod**: TerraPod is a digital video library. It allows you to outsource upload and data creation to the creators of the content (http://surferblue.wordpress.com).
- **Ex Libris**: It is a well known cloud service provider based in USA. It is providing cloud solution in the field of library with all the software and hardware support needed to provide services to the users. Ex-Libris is available for all type of libraries and for consortia. Ex Libris is built on various standard and contains number of features like compatibility with Unicode font, flexibility, migration of data, customization etc.
- **Polaris Library System:** It is one of the cloud based library automation system available in the market. The company also provides standard acquisition and processing system. Also, with a Polaris ILS Client License, the library can integrate various PC and print management systems at no extra cost. The systems use number of well known standards like MARC 21 for bibliographic data, XML, Z39.50 for information retrieval, Unicode etc.

Thus, the libraries, especially small one may utilize cloud computing facility. Online informational services such as NCLive which provides ebooks, audiobooks, computer-based training (CBT), journals and newspapers, information, and database searching can be better utilized through cloud computing (Long, 2010). However, LICs need to examine all the criteria before choosing any cloud service. Because, Pandya[6] (2012) warns that "when it is planned to use third party services one need to have thorough idea about the whole system. If one thinks that our all day-to-day activities can be moved then, first of all searching the standard company who has set of various software and hardware and experience in handling such services.

Impact of Cloud Computing on Library Services

Libraries are in a unique position to experiment with cloud computing with cloud computing given their service-oriented mission and need to find appropriate solutions using limited resources. The library community can apply the concept of cloud computing to amplify the power of cooperation and to build a significant, unified presence on the Web. This approach to computing can help libraries save time and money while simplifying workflows.

The improvements or benefits that library community can achieve with the application of Cloud Computing can be grouped in to three areas i.e., Technology, data and Community.

Technology Benefits: Cloud computing solutions are built on current technology and are architected to adapt for technology shifts. Looking at the explosion of mobile devices one sees how business and organizations operating in cloud environment are able to adapt and deliver their service to the new devices much more quickly and less expensively.

Library Management System (LMS) provides core library work such as acquisition, cataloguing, reporting, accounting and user management. These systems are generally closed proprietary systems. It has been difficult for these close proprietary systems to take advantage of new technologies as they emerge and also to integrate with external systems. For this libraries must rely on their vendors to do any such integration.

Eventually libraries need to add more systems to manage their ever increasing and ever changing collection which moves from physical collection management to combination of physical, licensed and digital collections. Integration of these systems becomes difficult and at times impossible.

What can change in cloud environment for managing core library services?

First would be the possibility of open service oriented architecture. Many cloud solutions offer this type of openness with published application program interfaces (APIs) that any programmer can take advantage of. This means if a new service or technology emerges libraries will not always be dependent on a vendor or other third party to start taking advantage of these services and technologies. Existing library systems have used APIs to connect to external services but they have remained closed proprietary systems making it hard to integrate them into external services.

Secondly libraries can get out of the business of technology and focus on collection building, patron services and innovation. Servers can be decommissioned and no longer require replacement every five years (or less). Staff no longer has to maintain the complex software stack necessary to run local systems and worry about compatibility of the stack during upgrades. Instead technical skills can be re-deployed for extending cloud services into their environment and their environment into other cloud services.

Data Efficiencies: When data is stored in the cloud it offers several advantages. Common data can now be easily shared among services and users. The need for local storage, maintenance and backups is removed. Agreements can be forged to share data that normally would be considered private to a single business or organization. And finally libraries can achieve Web scale when they massively aggregate data and users, something a cloud environment makes possible.

Like the advantages of technology deployed and accessed as cloud solutions, data storage in the cloud brings many benefits for libraries. The easy one to recognize is the same data being stored hundreds and thousands of times across libraries. Consider how many copies of the cataloguing data there are for a serial publication. And if a change is needed to the cataloguing data to keep it current each library must perform that change. When this data is maintained in the cloud, maintenance and backup of this data is now done once and if a change is needed, once one library performs the change all share it. Another great benefit of data stored in the cloud is the opportunity for collaboration and cooperative intelligence. Libraries can agree to share pools of data for cooperative collection building, cooperative preservation or digitization, cooperative sharing of materials, etc. And with massively aggregated data new services can be created such as recommender services based on a broad base of usage data.

Community Power: To create an online information community network, there exist two communities, the internal community of libraries collaborating within a single institution and across institutions and the external community of libraries and information seekers. The value to libraries is the "network effect" that coming together in the cloud provides. The cooperative efforts of libraries will create scale savings and efficiencies, bring wider recognition for libraries, and provide cooperative intelligence for better decision-making, and provide the platform on which libraries can innovate. The externally community can offer advantage of social media. Businesses and organizations can both build social communities around their services and participate in existing social communities such as Facebook or Twitter.

The internal community formed through the cloud offers new possibilities and efficiencies for current workflows. Many librarians have discovered the power of services like Google Docs to reduce the effort of working jointly. Services like these allow them to easily share ongoing work whenever they want and whenever they are.

The question arises, how do we use and where we use cloud computing in libraries? Cloud computing can transform

the way systems are built and services delivered, providing libraries with an opportunity to extend their impact. If one has used any of the popular Web 2.0 services over the past few years (e.g., Gmail, Wikipedia, Flickr or Twitter), then he may already have some experience with cloud computing, since most of these applications are hosted in the large online data centers that are the hallmark of cloud computing. Some of the benefits of cloud computing for the libraries may be summarized as below:

Cost savings: In an era of shrinking budgets, it gets harder with each passing year to justify the purchase and maintenance of servers that are not in use almost all the time. Loud computing offers price savings due to economics of scale and the fact that you are only paying for the resources you actually use.

Flexibility and innovation: Organizations of all sizes can take more risks when it comes to creative, innovative technology ideas when the new application will run on someone else's infrastructure. Libraries do not have decide between devoting their limited server resources to the OPAC's overflow traffic and a new mobile web application that one of your colleagues wants to develop. If they are both hosted in the cloud, the resources devoted to each will shrink and expand as traffic rises and drops. Furthermore, creating and configuring new virtual server instances is fast and easy in the cloud.

Broad, general IT skills Vs. deep, specialized skill: Cloud computing increases the pressure on IT professionals to become well-rounded employees with highly-developed managerial skills. Knowing how to configure and network a server is not enough. Systems librarians have to manage complex projects and evaluate competing vendors on a variety of criteria. Holding vendors accountable is especially important when they manage a significant chunk of your online data and IT infrastructure. Therefore, as long as cloud security remains a significant concern, techies may be called upon to help write binding, enforceable contracts that hold vendors to certain standards with regards to reliability and security of their services. Furthermore, techies will likely be part of the teams that periodically audit cloud vendors and ensure they are performing up to the contracted standards.

Cloud OPAC and Cloud ILS: Over the past few years, more and more ILS vendors have started offering cloud-hosted versions of their products. OCLC joined several other vendors when they began offering a cloud-based ILS tools that complement their existing cataloguing tools (e.g. WorldCat and FirstSearch). As individuals and members of organizations, we are already choosing between desktop applications when it comes to email, RSS, file storage, word processing and other simple applications. Sooner or later we will have to make this choice for mission-critical enterprise applications too.

Private clouds, hybrid clouds and community clouds: Libraries may soon be building and managing their own data centers. In addition to all the hype and optimism surrounding cloud computing, there are still significant fears and doubts industry challenges points out. In particular, the major cloud computing vendors have not yet fully addressed concerns about security, privacy and reliability. These concerns are leading some companies to build their own private or hybrid clouds. A hybrid cloud model would let libraries maintain more control over the applications and data stores that contain sensitive, private information about patrons. Moreover, libraries can continually adjust and fine-tune the balance between the tight control of a private IT infrastructure, and the flexibility and savings of cloud-hosted infrastructure. Just as libraries presently cooperate with one another to buy IT equipment, bandwidth and services of IT professionals, libraries may soon cooperate in the building and management of data centers. Alternately, if enough libraries express interest, a company such as Google, Amazon, Microsoft or another cloud vendor might create a Library Cloud similar to Google's Government Cloud. Or, a library vendor with deep IT resources (e.g., OCLC or SirsiDynix) might build library-centric cloud services on top of cloud infrastructure leased from one of the more established players.

Allow unfettered access to the cloud: Locked down PCs will not help users get to their data. This means offering multiple browsers, providing the fastest connections you can, and security measures that do not block access to what users want. Hardware access too: I carry a 160 GB portable drive everywhere with all of my stuff on it. I may need to plug it into your library computer someday to sync data. Lease let me.

Understand that the cloud may also be a valuable information resource in its own right. How many times have we answered a reference question via Facebook, Wikipedia, blog posts, a Flickr picture, etc. These are all viable means to get answers. Tap into user-generated data as a resource. It may become one of our most important mechanisms.

Utilize the cloud to save time and money: Be aware that Google Docs and similar will only get more share of the application market. May be offering access to Google Docs and instruction on how to use them would be a useful way to save time and money. That is why universities contracting with Google for applications and email. May be only a few computers in your library will need MS Office in the future. May be Open Office and some online version of the same will allow us a lot more freedom to spend our dollars and time on other improvements.

Understand the importance of personalization: People are personalizing their information experiences and spaces. Libraries should allow them to do the same with our systems and services. Look at some of the recent innovations with

OPACs to see where this is headed. Affording personalized connections into the cloud might make the library a gateway to user's data and put library resources in their view. Blocking access to Facebook? MySpace?-negates this benefit and dampens this possibility.

Don't miss the most important aspect: Localization – Many of the new social networking applications on the iPhone tap into using my location in various ways. It is messy, weird, kind of silly, but speaks to the promise of what could come. One might easily find vegetarian restaurants within a mile of a conference hotel via localized search on my device. One might tap into the wisdom of three other hikers while exploring a national park via services like "Find Twitter users near me." This is where the privacy discussion becomes so important. We need to understand how much is too much and how much is too little. Library is a service oriented system, which need high speed IN and OUT processing of data. It is good when data from these web based clouds is accessible to users?

Many library staff members are already experienced users of cloud computing-without even knowing it: Some are using the cloud in the form of Google Docs. Staff users of Facebook take advantage of cloud, as do those that use photo sharing services such as Flickr.

The important point to know about cloud computing is that it represents a paradigm shift in how we think about our data and the role of our computing devices.

Most people rely entirely upon their devices (desktop or mobile) to store information and run applications. How many have panicked over misplacing a presentation disc, accidentally deleting a presentation file, copying the wrong file version onto a USB key, or simply grabbing the wrong USB key? A misplaced mobile device or a PC crash is devastating since all data and applications are lost if not aggressively backed up.

With cloud computing, the focus shifts away from which devices can effectively store data and able to run applications and to which devices provide the earliest access to data and applications-which are stored at various places on the Internet. The iPhone has become very popular since it is in essence a cloud computing oriented service.

CONCLUSIONS

Libraries have the opportunity to improve their services and relevance in today's information society. Cloud computing is one avenue for this move into the future. It can bring several benefits for libraries and give them a different future.

The cooperative effect of libraries using the same, shared hardware, services and data – rather than hosting hardware and software on behalf of individual libraries – can result in lowering the total costs of managing library collections and enhancing the both library user's experience and library staff workflows. While local library systems served an important purpose earlier in library automation they now represent a tremendous duplication of effort. Each library builds and maintains a database, buys equipment and installs and updates the software. In fact, some libraries can get stuck in perpetual upgrade mode, which involves lots of testing and retesting and time consuming customization.

With cloud computing, all of this is taken care of transparently for the library and user. The vision is to use cloud computing to deliver library resources, services and expertise at the point of need, within user workflows and in a manner that users want and understand. It should free libraries from managing technology so they can focus on collection building, improved services and innovation. The cloud computing model will encourage libraries and their users to participate in a network and community of libraries by enabling them to reuse information and socialize around information. It can also create a powerful, unified presence for libraries on the Web and give users a local, group and global reach.

REFERENCES

Burford, David. (2010). *Cloud computing: A brief introduction*. LAD Enterprises Inc. Available online at: www.ladenterprises.com/pdf/CloudComputing.pdf (accessed on 25.06.2012).

Goldner, Matthew and Pace, Andrew. (2011). *Libraries and cloud computing*. Available online at: www.sla.org/PDFs/2011/ContribPaperGoldnerPace.pdf (accessed on 25.06.2012).

Hua, Nie. (2010). *Cloud computing – A China view*. Available online at: www.oclc.org/multimedia/2010/files/aprc/september2010/hua.pdf (accessed on 25.06.2012).

Kroski, E. (2009). *Library cloud atlas: A guide to cloud computing and storage: Stacking the technique*. Available online at: http://www.libraryjournal.com/article/CA6695772.html (accessed on 25.06.2012).

Long, Lauren. (2010). *More about cloud computing*. Available online at: www.sis.utk.edu/files/Long.pdf (accessed on 25.06.2012).

Pandya, Mithilesh Kumar. (2012). *Cloud computing for libraries: A SWOT analysis*. PLANNER 2012 Papers. Ahmedabad. INFLIBNET, pp. 387-94.

Parkhill, Douglas F. (1966). *Challenge of computer utility*. Boston. Addison-Wesley Educational Publishers, 208 p.

Sanchati, Rupesh and Kulkarni, Gaurav. (2011). Cloud computing in digital and university libraries. *Global Journal of Computer Science and Technology*, 11(12), 37-41.

Teregowda, P, Urgaonkar, B. and Giles, C. (2010). Cloud computing: A digital libraries perspective. In *3rd IEEE 2010 International Conference on Cloud Computing*.

http://en.wikipedia.org/wiki/John_McCarthy_%28computer_scientist%29

http://www.bus.emory.edu/ram/

http://en.wikipedia.org/wiki/Cloud_computing#cite_note-30

http://en.wikipedia.org/wiki/Steve_Ballmer