



## CLOUD COMPUTING: AN INNOVATIVE TOOL FOR LIBRARY SERVICES

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### ABSTRACT

Cloud computing is a new phenomena in the history of services which are offered over the internet., It has completely changed the way of use of the power of computers irrespective of any geographic location. The biggest benefit for organizations and businesses is that it offers services using hardware or software or platform of third party sources. It is very economical as it saves cost and maintenance. Cloud computing comes in several different forms. In order to minimize the cost and avoid duplication of resources, infrastructure, software, hardware, manpower use of emerging technologies like server virtualization and cloud computing in libraries are increasing.

In this paper, an attempt has been made to give an overview of how service, platform and infrastructure forms of cloud computing have been used to serve library needs.

This paper discusses about characteristics, types, advantages and disadvantages, role of cloud librarian, use of technology, initiatives of cloud computing. An attempt has also been made to overview the areas in libraries where this technology can be deployed to provide better library services and the productivity of library staff can be augmented.

**KEYWORDS:** *Cloud computing; Web 2.0; libraries; Cloud librarian.*

### INTRODUCTION

Cloud computing is making it possible to separate the process of building an infrastructure for service provisioning from the library of providing end user services. Cloud computing provides people the way to share distributed resources and services that belong to different organizations or sites. Cloud computing share distributed resources via the network in the open environment. It is a virtual pool of computing resources through internet. Cloud computing provides people the way to share distributed resources and services that belong to different Organizations or sites. Many companies, such as Amazon, Google, and Microsoft and so on, accelerate their paces in developing Cloud Computing systems and enhancing their services to provide for a larger amount of users. Cloud computing is broken down into three segments: "application" "storage" and "connectivity." Each segment serves a different purpose and offers different products for businesses and individuals around the world.

Libraries are using computers for running services such as Integrated Library Management Software (ILMS), website or portal, digital library or institutional repository, etc. These are either maintained by parent organization's computer staff or library staff. It involves investment on hardware, software, and staff to maintain these services and undertake backup and upgrade as and when new version of the software gets released.



Library professionals in most cases not being trained in maintaining servers find it difficult to undertake some of these activities without the support of IT staff from within or outside the organization. Now cloud computing has become a new buzzword in the field of libraries, which is blessing in disguise to run different ICT services without much of a problem as third-party services will manage servers and undertake upgrades and take backup of data.

### WHAT IS CLOUD COMPUTING?

Cloud computing is a new technology model for IT services which many organizations and individuals are adopting. Cloud computing can transform the way systems are built and services delivered, providing libraries with an opportunity to extend their impact.

Cloud Computing is internet based computing where virtual shared servers provide software, infrastructure, platform devices and other resources and hosting to customers on a pay-as-you-use basis. All information that a digitized system has to offer is provided as a service in the cloud computing model. Users can access these services available on the "Internet Cloud" without having any previous know-how on managing the resources involved.

### DEFINITION OF CLOUD COMPUTING

According to National Institute of Standards and Technology (NIST) "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."

According to the Gartner Group cloud computing as "a style of computing in which massively scalable and elastic IT-enabled capabilities are delivered as a service to external customers using Internet technologies."

According to the Forrester defines cloud computing as "A pool of abstracted, highly scalable, and managed compute infrastructure capable of hosting end-customer applications and billed by consumption."

Cloud computing is a type of computing that relies on sharing computing resources rather than having local servers or personal devices to handle applications.

### Essential Characteristics of Cloud Computing

NIST has identified five essential characteristics of cloud computing: on-demand service, broad network access, resource pooling, rapid elasticity, and measured service. Cloud services exhibit five essential characteristics that demonstrate their relation to, and differences from, traditional computing approaches:

**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 a 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) as well as other traditional or cloud based software services.

**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 degree 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 data center). Examples of resources include storage, processing, memory, network bandwidth, and virtual machines. Even private clouds tend to pool resources between different parts of the same organization.

**Rapid elasticity:** Capabilities can be rapidly and elastically provisioned in some cases automatically to quickly scale out; and rapidly released 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 usage by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, or active user accounts). Resource usage can be monitored, controlled, and reported providing transparency for both the provider and consumer of the service.

**Multi Tenacity:** It is the 6th characteristics of cloud computing advocated by the Cloud Security Alliance. It refers to the need for policy driven enforcement, segmentation, isolation, governance, service levels, and chargeback/ billing models for different consumer constituencies.

It is important to recognize that cloud services are often but not always utilized in conjunction with, and enabled by, virtualization technologies. There is no requirement, however, that ties the abstraction of resources to virtualization technologies and in many offerings virtualization by hypervisor or operating system container is not utilized.

### CLOUD COMPUTING MODELS

Cloud Providers offer services that can be grouped into three categories.

**Software as a Service (SaaS):** In this model, a complete application is offered to the customer, as a service on demand. A single instance of the service runs on the cloud & multiple end users are serviced. On the customers' side, there is no need for upfront investment in servers or software licenses, while for the provider, the costs are lowered, since only a single application needs to be hosted & maintained. Today SaaS is offered by companies such as Google, Salesforce, Microsoft, Zoho, etc.

**Platform as a Service (PaaS):** Here, a layer of software, or development environment is encapsulated & offered as a service, upon which other higher levels of service can be built. The customer has the freedom to build his own applications, which run on the provider's infrastructure. To meet manageability and scalability requirements of the applications, PaaS providers offer a predefined combination of OS and application servers, such as LAMP platform (Linux, Apache, MySQL and PHP), restricted J2EE, Ruby etc. Google's App Engine, Force.com, etc are some of the popular PaaS examples.

**Infrastructure as a Service (IaaS):** IaaS provides basic storage and computing capabilities as standardized services over the network. Servers, storage systems, networking equipment, data centre space etc. are pooled and made available to handle workloads. The customer would typically deploy his own software on the infrastructure. Some common examples are Amazon, GoGrid, 3 Tera, etc.

Cloud computing is defined to have several deployment models, each of which provides distinct trade-offs for agencies which are migrating applications to a cloud environment. NIST defines the cloud deployment models as follows:

**Private cloud:** The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise.

**Community cloud:** The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on premise or off premise.

**Public cloud:** The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.

**Hybrid cloud:** The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).

### COMPONENTS OF CLOUD

A Cloud system consists of three major components such as clients, data centre and distributed servers. Each element has a definite purpose and plays a specific role.

**Clients:** Clients in a cloud computing architecture are similar to the clients of everyday local area network (LAN). These are the computers which are residing on the desk of the end users. This is where the front-end applications are installed. They can be laptops, tablet computers, mobile phones or PDAs. In short clients are the devices at the user side and used to manage client information. The physical specification brings the client into the following three categories.

- **Mobile-** Mobile devices include smart phones, Tablets or PDAs.
- **Thin-** These are the dumb terminals having no hard disk space rather it let the servers do all processing activities. It simply displays the information.
- **Thick-** This type of client is a regular computer, using a web browser like Firefox or Internet Explorer to connect to the cloud.

**Data Centre:** The data centre is the collection of servers where the applications to which the user subscribes are hosted. A data centre server can be virtualized in nature where the software can be installed in the main physical server but appeared as separate server identity to the user. In this way, one can have half a dozen virtual servers running on one physical server.

**Distributed Servers:** It is not necessary that the data centre always contains only one server in our place. Sometimes servers are placed in geographically disparate locations in the globe. But from the end user perspective it seems that data is coming from a central server. In this approach if one server is down or instantly not available to a client request, may be due to congestions etc., the other services activate to cater the clients. In order to provide seamless service to the client, the data in these servers are synchronized frequently.

### ADVANTAGES OF CLOUD COMPUTING IN LIBRARY SERVICE

- **Cost reduction-** Ability to increase or decrease the consumption of hardware or software resources immediately and in some cases automatically.
- **Scalability-** "Pay as you go" allowing a more efficient control of expenditures.
- **Lower investment, reduced risk-** Immediate access to the improvements in the resource proposed (hardware and software) and debugging.
- **Support included-** Enjoyment of the most advanced security procedures, availability and performance of providers with experience and knowledge in this type of service.
- **Greater security and accessibility-** Access to resources from any geographical point and the ability to test and evaluate resources at no cost.
- **Portability-** since the service is available over the web, the service can be availed through browser from any part of the world.
- **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.
- **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.

### DRAWBACKS OF CLOUD COMPUTING

The drawbacks are actually the same as those encountered by institutions that have information hosted outside of the entity. Whereas, in the case of hard-copy document files and at the enterprise level, this fear disappeared years ago, given the benefits of cost reduction in infrastructure management and security, in the case of digital data there is still a huge fear of putting our information in the hands of third parties. This fear arises due to issues such as confidentiality, theft, loss etc. Yet people are increasingly more likely to do so now that the use of Web 2.0 and social networks has become so widespread. There is nothing more sensitive than banking or personal data, yet this data is stored in servers over which we have no domain or ownership.

An institution might take the decision to progressively move towards Cloud Computing by uploading applications which are not very sensitive such as: messaging, the booking of rooms, meeting management, the liquidation of costs, and holiday management. Following this learning process, more valuable information involving the corpus of the institution, i.e. "Business intelligence" might be uploaded to the cloud. In the case of libraries and information centers, this information would include management funds and network transactions.

### Disadvantages

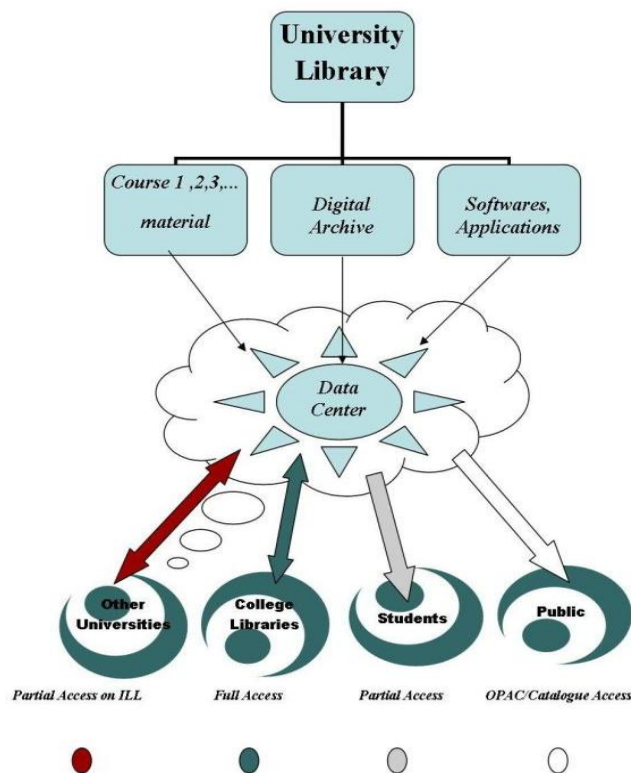
Like any other technology, cloud computing also has some disadvantages. Here are the mains:

- **Privacy and security of Data** - It is very big concern that there is a risk about the privacy and security of data. It can be accessed by others in cloud and it is more risky when the data is sensitive such as credit card information of customers. If the proper security model is not yet in place, then the data stored on the cloud is vulnerable to attacks from viruses, theft, etc. In addition, there is also the risk of data loss if there is system failure or improper backup. The physical location of servers is difficult to find as these services are provided through internet. It is hard to undertake the audit of software and security.
- **Network connectivity and bandwidth** - It is also a big concern that this service is directly connected to internet connectivity. If there is connection failure, then the user cannot access because this service is provided through internet. Also more bandwidth is required, as it may not work on low-speed Internet connections<sup>19</sup>.
- **Providers are supreme power** - As these services are provided by third party, the organizations have very little power to maintain or customize the services. It is very difficult to access the physical location of servers and the organizations have to depend on the service providers. Also the organizations are totally dependent on provider for backup, updates, restore and disaster recovery.
- **Flexibility is limited** - It has limited flexibility for the user as cloud computing is provided by third party. So there is little scope for customization as per specific requirements.
- **Cost** - Initially the cost of this service could be higher as there are some common services for all. The organizations can reduce by more usage of these services. However, cloud computing providers may increase the cost of their services in the future and organizations may end up paying higher charges.
- **Knowledge and integration** - It is very important requirement that the organizations have their own IT staff who have knowledge of cloud computing. Otherwise it is dependent on the service provider. Likewise, it is difficult to integrate equipment used in data centers are different from that of peripheral equipments in the organization such as printers, USB drives, etc. So it is difficult to integrate and the integration is also an issue.

### LIBRARIES AND CLOUDS

Today we are living in the age of information. Information technology plays a very vital role in handing library resources ranges from collection, storage, organization, processing, and analysis of information dissemination. Library field facing many challenges in the profession due to applications of information technology. New concepts and technologies are being added to ease the practices in the libraries and satisfy the needs of the knowledge society. With the advent of information technology, libraries have become automated which is the basic need towards advancement followed by networks and more effort are towards virtual libraries.

The emergence of digital library, internet usage, web tools application for libraries, consortium practices leads to the advancement in library profession. Cloud computing is a completely new IT technology and it is known as the third revolution after PC and internet in IT. The later technology trend in library science is use of cloud computing for various purposes and for achieving economy in library functions. Since cloud computing is a new and core area the professionals should be aware of it and also the application of cloud computing in library science.



### ROLE OF CLOUD LIBRARIAN

- To track member information and transactions
- To provide Access Pin to students and define validity. (Pin can be auto generated; Validity can be set in the software)
- To communicate with the member libraries contributing their resources to cloud for resource sharing
- To communicate with the Ebooks, Journals publishers & distributors, consortia, database providers
- To discuss with faculty members and subject experts, librarians for preparing different packages for different faculties and classes.
- To update technological skills
- To give technological support to member libraries
- To conduct training and awareness programs for readers
- To provide interlibrary loan facility
- To track usage record of cloud resources
- To develop digital collection
- To keep record of physical resources too for providing referral service To deal with Cloud resource and players and select the best bargain.
- To maintain own virtual profile by creating his or her blog or social network profile to interact with the user. The same platform can be used for providing

### CONCLUSIONS

Cloud computing is a new phenomena in the computer systems technology. It emerged due to the developments in internet and associated technologies. This phenomenon is in developing stage and will be very helpful for the organizations, if the services are being used with care. However, this technology is very helpful for organizations like libraries in automating and managing their services. This technology has certain advantages. With the help of this technology, library staff will be free from managing the servers. It is commonly seen that it is difficult for library professionals to manage the

technologies. The reasons may be their skill levels; there may be lack of support from IT section or absence of IT facilities in the organizations. In these circumstances, the library staff hinders in undertaking automation of library activities or developing digital library services, etc. This technology can be of immense importance in helping libraries to undertake modern ICT activities. The library professionals need not to worry technical side of ICT activities. They only have to add content of resources. Libraries in the west countries have already been using the cloud computing technology for their resources. Slowly the awareness about this technology is spreading in other parts of the world and with the use of ICT and internet; library professionals are sharing their library resources with others on the platform. Thus this technology will be of immense use to libraries, if handled with utmost care and awareness about its disadvantages.

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