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Cloud Computing for Libraries: An Economic Strategy

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ABSTRACT
In the last few years, the implementation of the cloud computing is emerging as a business concept to one of the fastest growing segments of the IT industry. Thus, resources would be switched on the application of need, which could be accessed to computing and storage system as the requirement of the user. Cloud computing can be useful for library automation and digital library resources to improve information sharing capabilities, improve resource utilization and user can retrieve data from anywhere. This paper introduces the foundation of cloud computing with the basic technologies, such as the virtualization and web services. Then, it explains the Cloud computing architecture and the purpose of applying it in the libraries and the merits, features, types of services to be selected before putting the data in the cloud and how the information is shared by using the cloud. Some case studies of such organizations which have put their data in cloud are included.

Keywords: *Cloud computing, Resources sharing, Grid computing, IaaS, PaaS, SaaS, Cloud computing in India*

INTRODUCTION

Cloud computing is among the most popular recently developed concept and there is still a lack of clear and unified definition for this. By using virtualized computing and storage resources and modern web technologies, cloud computing provides scalable, network-centric, abstracted Information Technology infrastructures, platform, and application on demand. These services are billed on a usage basis. Specifically we can say, Cloud computing is the improvement over parallel computing, distributed computing, utility computing and grid computing. There are varying definitions for the term cloud computing; the National Institute of Standards and Technology (NIST) offers the following working definition: "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". Cloud computing refers to applications and services that run on a distributed network using virtualized resources and accessed by common internet protocols and networking standards. The Gartner Group defines 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".

MODELS OF CLOUD DEPLOYMENT

- **Public Cloud**: The public cloud is mainly for public use, which can be accessed by everyone. It is mainly use by large organization or institution.
- **Private Cloud**: It is infrastructure to be operated within the organization, for the users who wants to share specific information within the institution.
- **Hybrid Cloud**: This type of cloud computing environment consists of both internal and external providers employing both private and public clouds.
- **Community Cloud**: A community cloud is applied to serve a common function or purpose. It may be for one university or for several universities, but they share common concerns such as their mission, policies, online resources, union catalogues, security, regulatory compliance needs, and so on.

TYPES OF CLOUD COMPUTING

Infrastructure as a Service (IaaS): The IaaS layer gives the user a limited view on the hardware, which is computers, mass storage systems, networks, etc. This is achieved by providing a user interface for the management of a number of resources in the resource set sub-layer (RS). It enables the users to allocate a subset of the resources for their own use. Typically

functions available from the user interface include creating or removing operating system images, scaling required capacities, or defining network topologies. Here given few examples:

Table 1: Infrastructure as Service: Offering and Tools

Organization	Cloud Services	Description
Amazon	Amazon Elastic Compute Cloud (EC2)	Provides users a special virtual machine (AMI) that can be deployed and run on the EC2 infrastructure
Amazon	Amazon Simple Storage Solution (S3)	Provides users access to dynamically scalable storage resources
IBM	IBM Computing on Demand (CoD)	Provides users access to highly configurable servers plus value added services such as data storage
Microsoft	Microsoft Live Mesh	Provides users access to a distributed file system; targeted at individual use
Dropbox	Dropbox Cloud storage	Mass storage
Google	Google Big Table	Distributed storage of structured data
University of Chicago	Nimbus	Open source IaaS

Platform as a Service (PaaS): The cloud services provided on the PaaS layer are usually not targeted to the end users, but rather to developers. These are the programming environments (PE) and executive environments (EE) where the proprietary software written in a specific programming language can be executed. The examples of PaaS are:

Table 2: Platform as a Service: Offering and Tools

Organization	Cloud Services	Description
Akamai	Akamai EdgePlatform	Large distributed computing platform for web application deployment (focus on analysis and monitoring of resources)
Salesforce	Force.com	Platform to build and run applications and components bought from AppExchange or custom applications
Google	Google App Engine	Platform to develop and run applications on Google's infrastructure
Microsoft	Microsoft Azure Services Platform	On-demand compute and storage services as well as a development platform based on Windows Azure
Facebook	Facebook Platform	Environment for the applications in the Facebook social network
Yahoo	Yahoo! Open Strategy (Y!OS)	Platform to develop and web applications on top of the existing Yahoo! Platform

Software as a Service (SaaS): Cloud software applications that directly address the end user belong to the SaaS layer. This model frees the customers from the need to install the software locally and thus to provide the required resources themselves. Seen from the cloud architecture perspective, the SaaS offering can be developed and operated by the provider on the basis of PaaS or IaaS offering. The examples are:

Table 2: Software as a Service: Offering and Tools

Organization	Cloud Services	Description
Google	Google Apps	Web-based office tools such as e-mail, calendar and document management tools
Salesforce	Salesforce.com	Full customer relationship management (CRM) application
Zoho	Zoho Creator	Large suite of web-based applications, mostly for enterprise use
Microsoft	Microsoft Live	Online operating system and office application
Adobe	Photoshop Express	Online image processing
OpenID	OpenID Foundation	Distributed cross-system under identity management system

These services can be used in libraries as:

Table 4: Services for the Libraries

Platform	Systems	Examples
Software as a Service (SaaS)	OpenURL resolver, Research guides, Online reference, Server Virtualization, Load Balance	Google Apps, OpenID, Salesforce.com, Adobe, Microsoft
Platform as a Service (PaaS)	Integrated library system, Interlibrary loan, Copyright, Compliance systems	Akamai, Microsoft Azure, Zoho, NetSuite, Facebook Platform
Infrastructure as a Service (IaaS)	Discovery systems, Digital repository, Archives management, Websites, Digital storage, Institutional repository	Amazon Elastic Compute Cloud (EC2), Dropbox, Rackspace, IBM, TCS, Joyent, OpenNebula

Why Businesses and Institutions are adopting Cloud Computing Solutions?

Jeff of Amazon repeatedly said that 70/30 rules states that any employer of a business or organizations spend his 70 per cent of time and money in maintaining the infrastructure to maintain his business going well. Therefore only 30 per cent of time and money owner can spend for working on innovative and other ways for the improving and the growth of his business. So if the business moves its application in Cloud based solution, then the ratio will invert thus now giving 70 per cent of time and money to improve and grow the business.

John Waters gives an example of this rule at work. He is executive director of the Minnesota Online High School (MNOHS), which supports all of its courses over the Internet for its students. Explaining why the school switched to a cloud solution he states: "We were collapsing under the weight of the need to support so many different computers. Until recently, the school provisioned those computers by sending out CDs, DVDs or its licensed software and guiding students through downloads or the open source and custom applications it uses. MNOHS began looking for a better way. The school launched a pilot program to test a system designed to move its entire operation to the cloud. Student work doesn't reside on computers anymore. All the applications and data are stored in the cloud. No more CDs or DVDs. No more downloads. And if a laptop dies or gets stolen, student work isn't lost".

What can Cloud Computing do for Libraries?

Libraries are changing from the manual recording to automation in functions such as cataloguing, circulation, OPAC, and Institutional repository. Electronic vendors, Electronic resources management, Resolver, etc., are now looking out for students with computer science or information technology background and not with library science background. Not only cloud computing can overcome these problems, but also it can give us architecture which would be cost efficient enough to handle large-scale

data. Because libraries widely see the transformation of user communities engaging through Web 2.0 and user generated content. In order to manage hybrid library resources, integrating their workflow processes is inevitable for managing library operations.

Case Studies-I

University of Mysore is using cloud in university library. After an extensive survey and analysis, an Expert Committee consisting of senior library professionals and teaching faculty of University of Mysore recommended the adoption of KOHA, an open source Integrated Library Management System (ILMS) for automating libraries under university including main Library. Presently they have more than 125,000 records which have been converted from legacy systems and loaded on KOHA. It is hosted on Amazon EC2 platform; this too is something new in the Indian Library scenario. They also implemented the mobile OPAC keeping in view the mobile density among the users. The OPAC is available here: (http://libcat.mysore-univ.org).

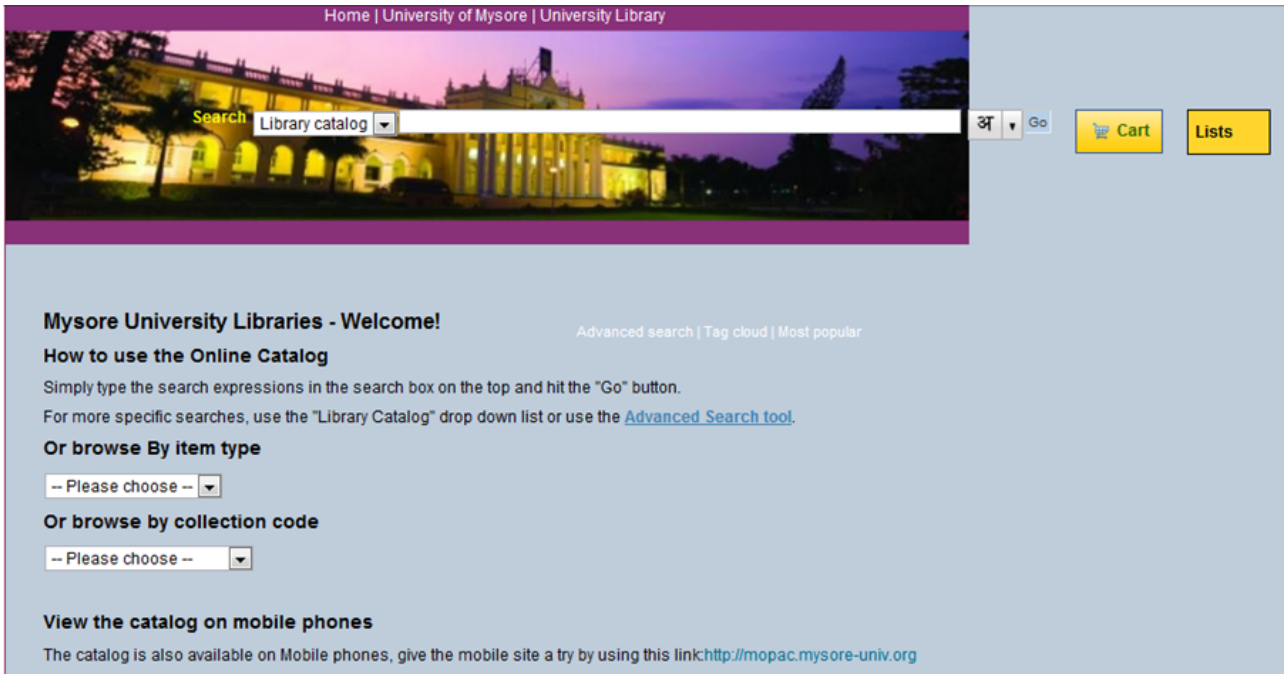

Figure 1: Online Catalog of Mysore University Libraries in Cloud

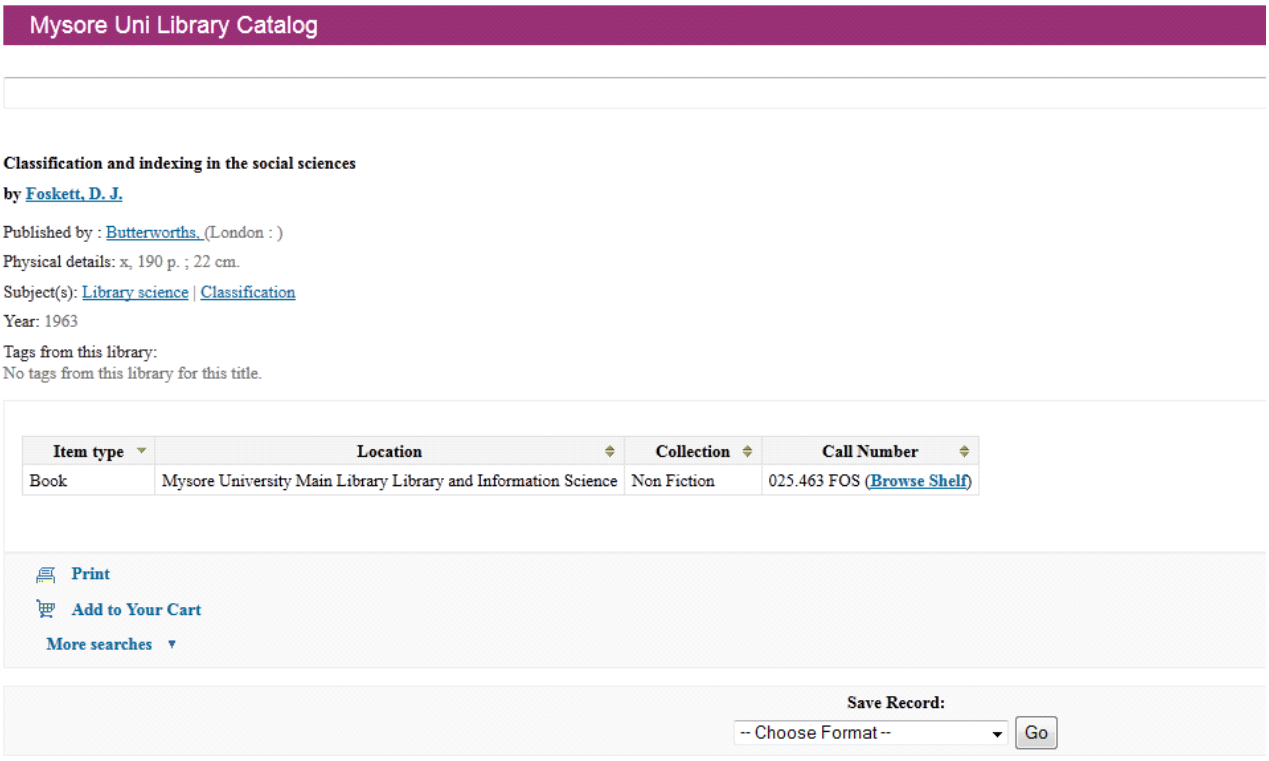

Figure 2: Mobile OPAC of University of Mysore Library

Case Studies-II

LibraryThing is one of the websites for the combination of Cloud computing and social networking. Based in Portland, Maine, LibraryThing was developed by Tim Spalding and went live on August 29, 2005. As of July 2012 it has over 1,550,000 users and more than 74 million title catalogue. LibraryThing is a social cataloging web application for storing and sharing book catalogs and various types of book metadata. It is used by individuals, authors, libraries and publishers. 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 interests. This site also contributes web services for libraries after paying a nominal fee it allows libraries to draw on the vast database of recommendation and other users available in Library Thing. (Fox 2009)

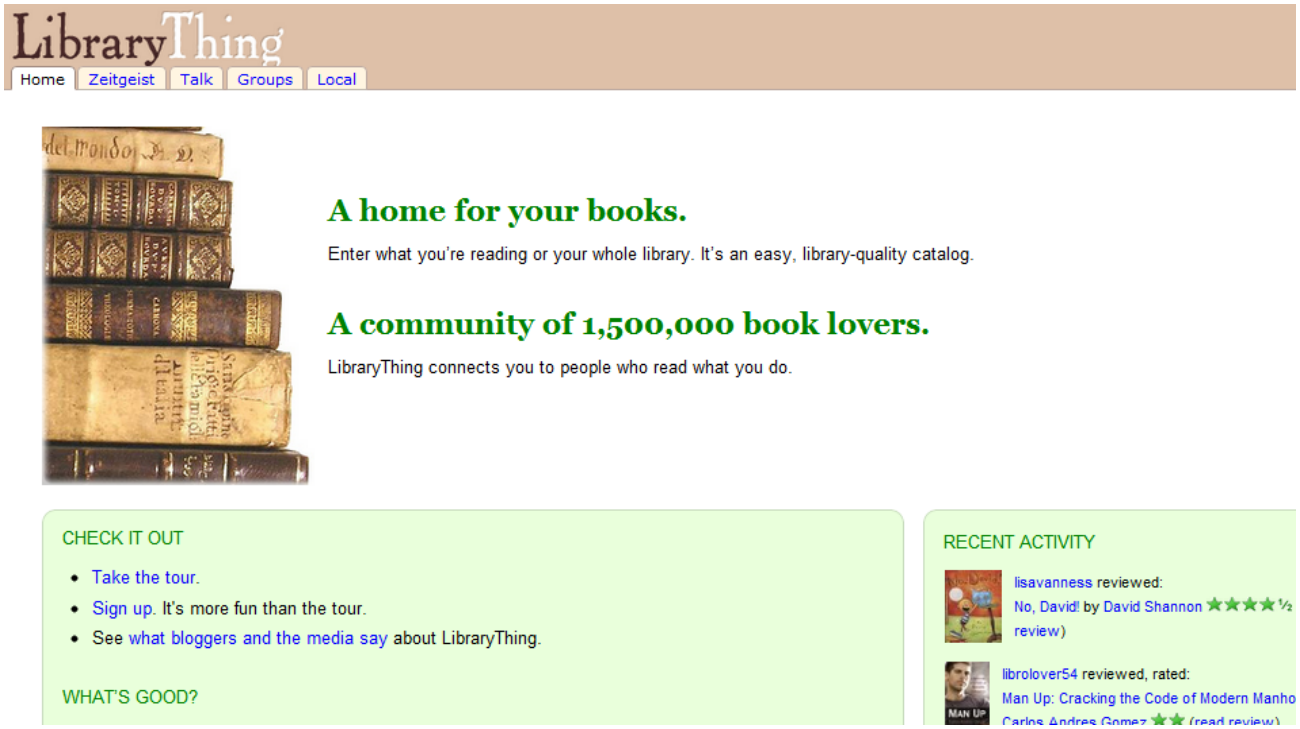

Figure 3: LibraryThing in Cloud

CONCLUSION

We know that not only library is a knowledge ocean, its main goals is to provide satisfactory services for the all the users. Cloud computing would be a developing trend for computing network in future, which had been widely used in various other fields. Libraries are trying to improve the services in today's information society. Cloud computing is one of the efficient ways to negotiate this change into the future. The cloud is already busted we only need to get ready to welcome the showers of knowledge and adapt it in our universities or institution in future.

RESOURCES FOR CLOUD COMPUTING

Library Management Applications

- <http://www.librarything.com> – simple cataloging and social discovery
- <http://www.liblime.org> – consulting and hosting for Koha open source ILS
- <http://www.oclc.org/webscale/> – full-featured cloud-based ILS

Bibliographic Management Applications

- <http://www.refworks.com/> – online citation management
- <http://www.zotero.org/> – online citation management and social discovery

Office and Calendar Applications

- <http://docxs.google.com/> – word-processing, spreadsheets, presentations, excel, etc
- <http://www.zoho.com/> – documents, project management, accounting etc

Multimedia Editing Applications

- <http://www.wevideo.com> – simple online video editor
- <http://www.screenr.com> – cloud-based screencasting

Infrastructure as a Service

- <http://aws.-amazon.com/ec2/> – scalable computation resources
- <http://code.google.com/appengine/> – scalable application hosting

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