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Library Automation in India: Assessment of Library Services Platforms

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ABSTRACT

Automation efforts in libraries have moved from standalone database systems to cloud-based systems, traversing generations of library management system (LMS) and integrated library management system (ILS) in between. This paper attempts to traverse this transition with emphasis on present-day technological state-of-affairs in the libraries. The traditional terminologies vis-à-vis the cloud associated architecture has been touched upon. The paper introduces library specific tenant- based software services over the cloud architecture and also the associated maturity model. Apart from ILS, other facets of library automation have been talked upon with examples from libraries providing such aggregation or dissemination services. The paper lays special emphasis on library service platforms in use in India. An internet search was done to locate the cloud- based library software in use and thereafter a listing of major vendors and providers promoting these software were made. Questionnaires were sent to such vendors and exploratory study was conducted to overcome the non-respondent bias and the usage statistics extracted. Koha was found to be the most common open source in use over the cloud through a paid support from three of the eleven vendors in India. Only two clouds- enabled proprietary software are available at present, e-Granthalaya and Cybrarian™ with former having the support from Government and hence has more installations. A detailed analysis on suitability of an ILS for a library indicated that single-tenant SaaS model suits large libraries while small group of homogeneous libraries can do with multi-tenet SaaS model. Still, library SaaS is in its infancy in India.

Keywords: Cloud computing, web services, library automation, library services platforms, SAAS model

1. INTRODUCTION

Library automation started in India three decade ago and the initial systems were stand alone applications for each library activity. Such systems were hosted on main frame computers offered by 3rd generation programming languages like COBOL based on file system. Such applications inherited the problems associated with file-based systems, i.e., poor accessibility, data redundancy, poor file access and arbitrary data organisation. The advancement and proliferation of computer and communication technologies and cost reduction coupled with the affordable relational database management systems (RDBMS) for data management have resulted into the development of library management systems (LMS) more appropriately, integrated library systems (ILS). Such multi-users ILS applications were based on client-server architecture and made accessible to users through local area network (LAN). The advent of Web 2.0 semantic bolstered the ILS vendors' confidence and offered library services over internet through a browser. This technology has removed the lacunae of client -based applications and opened flood gates for new generation ILS.

Libraries do need hardware and software for hosting and accessing their services, and can now be achieved using either local or cloud hosting. In case of local hosting, installation of hardware and software is a prerequisite and it has to be maintained for uninterrupted service, draining out the meagre library budget and staff. Cloud technology replaces this work of in-house staff or IT people. Therefore, the staff engaged in manning IT activities can be utilised for strengthening the entire gamut of library services.

Library systems based on cloud computing differ substantially from the traditional library systems, and are called library services platforms (LSPs): a term coined by Marshall Breeding[1]. These systems are developed on Service Oriented Architecture (SOA) and also include application programming interfaces (APIs) for interoperability and extensibility which is a prerequisite for deployment through multi-tenant SaaS model.

The deployment scenario of a traditional library management software is depicted in Fig.1. To remove ambiguity in narration, if any, the following definitions are used.

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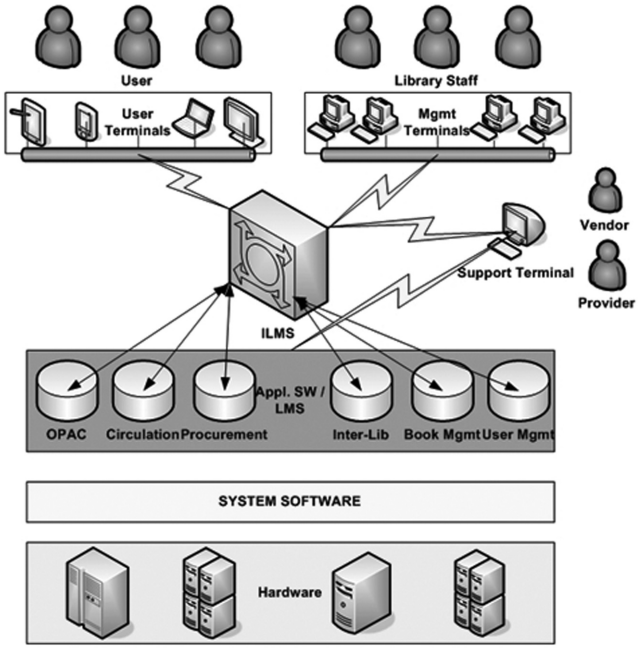

Figure 1. Deployment scenario of a typical library software system.

Application-An application is a coded algorithm with human computer interface for receiving inputs from the user to activate or provide data for the application. The application software cannot interact directly with the computer hardware but has system software at the intermediate level which interfaces the application executes with the processing and input-output hardware. The term in this paper context refer to ILS.

Customer-The term 'e-customer' refers to a library in context of next generation library system (library services platforms). The term is used wherever cloud technology is discussed for libraries.

Integrated Library System (ILS)-An LMS provides a group of application software to automate various library activities related to procurement, circulation, user management, book management, walkthroughs, inter-library interactions, indexing, etc., these activities can operate in silos or can be integrated to work in coordination like a Library resource management system. Such interlinked and coordinated software is also termed as integrated library system (ILS).

Library Services Platforms (LSPs)-The term was coined by Marshall Breeding1. The next-gen ILS is steered by the rapid advancements in the area of computer science and is adapting itself to the state-of-the-art forthcoming hardware architectures and software technologies. Cloud computing is an area which leverages the benefits of contemporary hardware platforms as well as the software paradigms.

Provider-The organisations, institutions or companies, who provide support for installation, operation and maintenance of open source library software (e.g. Koha, NewGenLib) against some fee.

User-The person uses the services provided by a library and is the person who consumes information.

Vendor-Organisations, institutions or companies those who develop applications (ILS or LSPs) and offer to libraries against payment.

2. CLOUD COMPUTING

Cloud computing represents cloud as 'Internet' and computing as 'computer technology'. For librarians, it is a library application that is hosted on a remotely located server on internet. The hosting infrastructure on internet is called Data Centre and generally owned by third party or vendors. The present day web-based internet-enabled library services can be accessed by the user through a browser. In simple terms, majority of electronic resources and applications used by libraries are hosted on internet[2].

The use of this technology provides a cost effective, reasonably secure and reliable data storage, facilitates data sharing and also guarantee against accidental data damage and virus attacks. Therefore, librarians must understand various features of cloud computing before implementing for its effective use in library system. Since security certification feature has already been discussed in details by Carl Grant[3] the same is excluded here. However, SaaS, multi-tenancy and single tenancy shall be elaborated from libraries points of view.

3. SOFTWARE AS A SERVICE (SAAS)

SaaS is defined, in a simple way as, 'software deployed as a hosted service and accessed over the internet[4] and is a different way of delivering it on cloud. In this model, libraries use a remotely hosted server on internet instead of local server. Library also hires the hosting services of a remote server from another vendor by paying some fee. The vendor deploys the application and provides maintenance service to the library. Some vendors also offer the hosting services either owned by them or hired from a 3rd party. In these arrangements library has to make single agreement for hiring server for hosting and associated software. The services are available to library users on 24x7 basis through terminals connected to internet. In SaaS model, library staff is relieved from maintenance of the IT-infrastructure and overhauling activities. A well-designed SaaS application has the following features from the architecture's points of view:

(a) Scaling

It means the capability of the application to simultaneously handle multiple requirements and

seamlessly provide the same quality of service with increase in the number of requests with time. Scaling is achieved by incorporating a variety of features like enhancement of cache, optimisation of session timeouts, peering of resources, data synchronisation, updates and using special databases.

(b) Multi-tenancy

It is a very important issue in cloud system for the software development. Multi-tenancy is an architecture in which a single instance of a software application serves multiple customers[5]. Each customer is called a tenant. Each tenant may be authorised few options of the application e.g., color of user interface, or business rules but not in code. In this model the vendor only needs to update once for all the customers. Carl Grant has discussed the importance of this architecture for libraries[3]. The location of data and code in generally unknown to the customer and same resource may be assigned to multiple users simultaneously. The data, applications, and services are hosted on shared resources but made available as an isolated instance to each customer.

(c) Configurable

If a single application instance on a single server has to accommodate users from several customers at once, one can not simply write custom code to customise the end-user experience—anything done to customise the application for one customer will change the application for other customers as well. Instead of customising the application in the traditional sense, each customer uses metadata to configure the way the application appears and behaves for its users. The challenge for the SaaS architect is to ensure that the task of configuring applications is simple and easy for the customers, without incurring extra development or operation costs for each configuration.

3.1 Multi-Tenant SaaS Architecture

'In a multi-tenant architecture (also known as single instance), data from multiple customers is stored on the same server, usually separated by a partition to prevent the data from migrating from one company to another[6]. All applications are housed on the same server, there must be a standard SaaS architecture that includes the same configuration capabilities for the hardware, network, and operating system for all customers, known as tenants.

In SaaS model (Fig. 2) all libraries use a replicable instance of program suite to manage and manipulate data stored in a multi-tenant database shared by many libraries. Libraries are debarred to make any changes in pre-designed functionality. It is useful for libraries having no requirements of any alteration in the application and having a common set of rules.

3.2 Single-Tenant SaaS Architecture

'Single-tenancy SaaS architecture (also called multi-instance) is where a separate instance of a software application and supporting infrastructure is

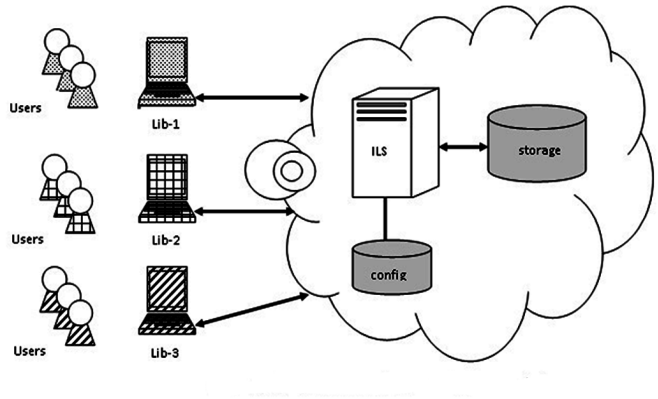

Figure 2. Multi-Tenant (single Instance) SaaS model.

used by each customer or tenant[7]. This architecture is suitable for libraries who require customisation for providing higher level of data security.

For single-tenancy SaaS environments, depicted in Fig. 3 every tenant procures its own copy of the application, customised as per its need. With flexibility in-built on the model the libraries can customise software features such as modification in individual modules and access approach to various in-house databases (OPAC) and external databases such as e-journals access and open access journals.

3.3 Choice of Single-Tenant or Multi-Tenants SaaS

Multi-tenancy model are supposed to be highly secure and provide adequate functionality for the

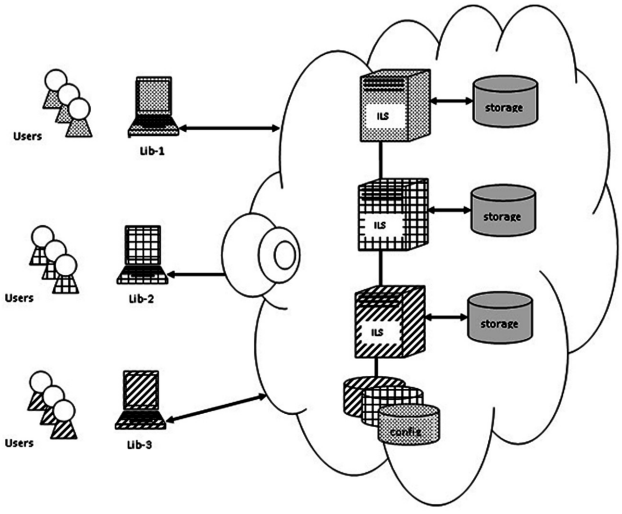

Figure 3. Single tenant (multi instance) SaaS model.

needs of most libraries. Single-tenancy model provide even greater security since potential danger for data migration is eliminated. It is therefore imperative that single-tenancy model is preferred by customers because of data safety, e.g., that is a legal requirement and also satisfying government protocols.

4. SAAS MATURITY MODEL

SaaS and its two important attributes for making a mature SaaS application have been discussed. An application may possess one of the attributes and still meet necessary business requirements but it may not be cost-effective.

SaaS application maturity is expressed with four distinct levels[8]. Each level is distinguished from the previous one by the addition of one of the three attributes (scaling, multi-tenancy, and configuration).

- **Level I- Ad hoc/Custom**

This is a traditional delivery model where every customer is provided a separate copy of the application. Although this level is least cost effective, it allows vendors to reduce costs by consolidating server hardware and administration. This level lacks in all three attributes.

- **Level II- Configurable**

The base code remaining unchanged, the applications are configured and customised as per user requirements. This level lacks in two characteristics-scalability and multi-tenancy.

- **Level III- Configurable, Multi-Tenant-Efficient**

To implement multi-tenancy, the vendor provides a single instance that serves every customer who is allowed to using a self-service tool. This level lacks in scalability.

- **Level IV- Scalable, Configurable, Multi-Tenant-Efficient**

Scalability is an additional advantage over level 3 offering and is achieved through a load balancer to maximise the utilisation of data storage and computing power. This permits addition of new instances and merging them in the dynamic pool of instances. These characteristics render this level highly scalable.

The service oriented architecture (SOA) and application programming interface (API) play important role in library services platforms.

5. APPLICATION PROGRAMMING INTERFACE (API)

The API consists of programming modules for

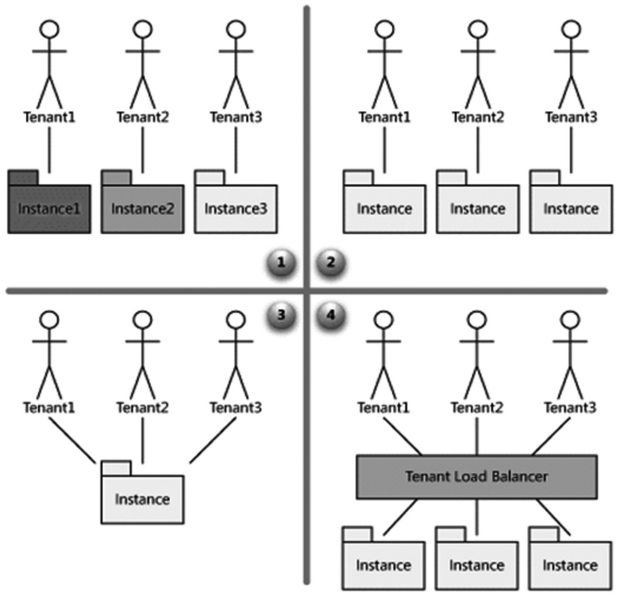

Figure 4. Four-level SaaS maturity model.

accessing web-based software application and is a software-to-software interface only. Applications communicate to each other through APIs and are user transparent. For example: product is ordered online through customer credit card, the information is transmitted to vendor's website using an API for verification. Once done, API responds back 'OK' to customer to confirm the order. Libraries may be able to access the data and functionality of their key systems through all pervading APIs, from proprietary to open source software. Access and usage of APIs shall be a key characteristic for forthcoming library services platforms. Traditional ILS products also offer this feature[9].

WorldCat Search API is being used by vendors in their ILS to search WorldCat and retrieve records for catalogued items such as books, videos and more in WorldCat[10]. This API is used by libraries that participate in WorldCat.org through their cataloguing and FirstSearch subscriptions.

The OpenSearch API of nature.com provides an open, bibliographic search service for content hosted on nature.com, comprising around half a million news and research articles and citations[11].

There are numerous APIs for several tasks in ILS. Z39.50 and SRU/SRW are Koha's APIs to access (bibliographic) databases. These do not define how the data is structured and indexed in the database.

A set of APIs (eRail.in) by Indian Railways is being used in their mobile apps to provide access to trains' information[12]. This API is a service providing information on Indian Railways through an HTTP request. These applications based on eRail. in have helped immensely passengers in taking right decisions.

6. SERVICE ORIENTED ARCHITECTURE (SOA)

The SOA means of designing and building software[13]. The model allows interaction among discrete services functioning in isolation. Software upgradion and modifications, when needed can be incorporated in SOA, obviating need to develop services from scratch. Clouds are API-driven, and therefore are service-oriented. Cloud computing wil enhance use of SOA in library services.

Since, SOA architecture applications are built using services and are open for third party developers for carving out their applications. Therefore, it can be termed that these are service-based APIs. In SOA, a developer can build a new application using the services of one or more applications developed on SOA.

7. LIBRARY AUTOMATION

Library automation in India has matured. Most of libraries have already completed the automation of all activities of libraries. The most common is online public access catalogue (OPAC). Number of libraries has also made available their OPAC to public through on internet which anyone with internet facility can search. The automation activity in libraries can be divided into three categories:

7.1 Online Database Services

Libraries have been using some cloud computing services for over a decade[14]. DESIDOC used to search online databases of Dialog during 1980s over Telex[15]. This was one of the applications of cloud services because application (search software) and databases were hosted on remotely located servers (in USA). The availability of PCs and modems (initially 300 bps) and PSTN were used in the beginning of 1990s. The availability of e-journals on internet, another application of cloud services, has been used by libraries in India since beginning of 21st century. Therefore, use of cloud technology is not new for providing library services. However, its use in providing services from library holdings having print and digital collections using cloud technology is still challenging task world-wide. In developed countries, number of vendors have either upgraded or are in the process of upgrading their traditional library systems (ILS) to library service platforms to take the full advantages of cloud technology.

7.2 Digital Collection

The library community in India has also started using IT technologies for managing digital collection. In India, it is observed that majority of the libraries preferred D-Space or E-Print for this. Most of the libraries have hosted this service on local server connected to Internet through LAN and made available to their users. These libraries also allow anyone having a browser and internet connection to search their digital collection. Efforts have also been made for incorporating interoperability features in some institutional repositories[16]. OpenLx, a service provider for Koha, claims that they have successfully tested hosting of DSpace on cloud and have a trial version[17].

7.3 Print Collection

Most of the ILS products are largely for managing print or physical collection and were developed before the internet and Web existed. These are generally closed proprietary systems. These were used initially for searching OPAC and later extended to cover all in-house activities such as acquisition, cataloguing, circulation, inter library loan (ILL), article indexing ,and serials control. In India, implementation of SRU for interoperability among OPACs of different libraries has been demonstrated and achieved long back[18].

7.4 Union Catalogues

Some national level institutions in India have made efforts for development of union catalogues of books and journals in their respective domains. DESIDOC, Bhaba Atomic Research Centre (BARC), National Aeronautics Laboratory (NAL), Developing Library Network (DELNET), Information and Library Network (INFLIBNET) are few examples of them. However, DELNET and INFLIBNET have been successful in achieving their goals up to some extent. DELNET has a collection of more than 203 lakhs bibliographic records pertaining to member libraries in their union catalogue of books and more than 36 thousands records of periodical titles in union catalogue of periodical titles[10]. Similarly, INFLIBNET has in developed IndCat, online union catalogue of Indian universities, which has a collection of 120 lakh records from 157 libraries[11].

7.5 IT Infrastructure

Libraries host these applications on a local server connected to LAN for providing access to their users and library staff. Some of the large libraries have also made their catalogue (OPAC) available on internet thus extended search facility to their users round the clock. In case of local hosting libraries, it needs in-house staff for maintaining the requisite computer hardware and software. This is not a problem for libraries having separate IT staff for supporting the IT services of other activities. However, it is a big challenge for libraries not having such facility.

The problem is more serious for larger libraries or consortium of libraries that need to provide access of their union catalogues to libraries spread

all over India and sometimes abroad also. For this they need large servers with high band width of internet facility to serve their large user base. This again needs more IT staff for maintenance of requisite hardware and software.

According to Jeff Bezos of Amazon 'businesses which run applications spend 70 % of their time and money supporting the infrastructure required to keep the business going[19]'. This only leaves them 30 % of time and money to work on innovation and way to improve and grow their business. He shows that when a business moves their core applications to a cloud-based solution, they can invert this ratio thus leading to improve and grow their business.

8. CLOUD COMPUTING FOR LIBRARIES

According to Library System Report 2014 by Marshall Breeding[20], there is significant increase observed in transition to cloud computing by libraries. This includes the large scale projects involving shared automation infrastructure for libraries throughout a region, state or country. Although there are pros and cons of this technology yet libraries have not only started exploring its use but some libraries have taken a lead in developed countries. Most popular products widely known are WorldShare™ Management Services by OCLC@, Alma by Ex Libris, Sierra by Innovative Interfaces, Intota™ by Serials Solutions, Open Library Environment (OLE) by Kulali@, and Open Skies by VTLS[3].

However, use of cloud computing technology is not as easy as it looks. Traditional library systems (ILS/LMS) are generally closed proprietary systems and it is not easy for these systems to take full advantage of this technology[21]. Use of cloud technology in libraries requires different approaches; each approach has its advantages and disadvantages. However, to understand these approaches there is a need to make comparisons at the technical level.

Today, SaaS applications are expected to take benefits of centralisation through a single-instance, multi-tenant architecture, and to provide a feature-rich experience in comparison to locally hosted applications. SaaS applications are completely managed by the vendor or SaaS hoster; in fact, the implementation of management tasks and responsibilities is opaque to the consumer. Service-level agreements (SLAs) govern the quality, availability, and support commitments that the provider makes to the subscriber.

Carl Grant[3] has discussed the following three approaches of library services platforms adopted by vendors:

(i) Develop an Entirely New Product

These systems build upon the advanced in architecture and therefore offer full advantages of new technologies including multi-tenant operations and incorporate requirements of both digital and print processes. The systems that follow this approach are WorldShare™ Management Services by OCLC@, Alma by Ex Libris, and Intota™ by Serials Solutions. In India, there is not a single system build on this architecture.

(ii) Integrate New Technology Features with Existing

These systems integrate additional new features with the existing system such as support for mobile users, integration of print and digital contents, and interoperability with third party systems. Sierra by Innovative Interfaces and Open Skies by VTLS adopted this approach. In India, CYBRARIAN™ by CR2 Technologies and E-Granthalaya by NIC use this approach.

(iii) Open Source Software Approach

Open source software approaches have been gathering momentum not only in developed countries but in India also. There are providers in the market to support efforts to develop open source library services platforms. OLE by Kulali and Koha are the example of this approach. It was seen that development of library services using OSS has picked up momentum but as far as library services platforms are concerned, it is still a long ways to go in India.

However, it is not mandatory to use cloud computing in one go. Libraries may prioritise their need carefully and moved in this direction using carefully drawn road map. They need to identify what are the services that may enhance the quality of service to users should be adopted first.

9. LIBRARY SERVICES PLATFORMS IN INDIA

India is not untouched from the use of this new technology. Libraries in India have also started taking advantages of cloud computing. A google search shows that there are number of, libraries having the presence of their OPAC or union catalogue on web. However, all of these are not using cloud technology. However, numbers of articles were found on 'cloud computing' and 'library automation'. A total of 84 articles were selected from Google Scholar search. Finally full-text of 23 articles on the topic were found.

A close scrutiny of these articles shows that most of the information available in these articles was about systems developed and used in libraries of developed countries.

Collected information have been from websites of leading 9 vendors (LibSys, CR2 Technologies, Softlink Asia, Algorhythms, NIC, Total IT Solutions, LibLime Koha, NewGenLib and Innovatives) 10 providers[22] in India and then sent one page questionnaire to

them through e-mail. The library services platforms were divided into two categories, i.e., open source and proprietary.

9.1 Open Source ILS Software

It is the only OSS among library services platforms available in India. Koha is a SaaS offering and not a true cloud computing system because it does not offer data management for both print and digital collection. Libraries must also select their own SaaS hosting. Koha is web-based open source ILS first released in 1999[22]. It facilitates access from a computer having web browser and connected to the network. Koha 3.0 was released in 2005 with Zebra indexing engine. Koha Express based on SaaS model was released in Sep 2009[23]. It is reported that with the help of specialised support firms (providers) more than 3,000 public, school and special libraries in the world are using Koha[24]. Its latest version 3.18.5 was released on 22 Mar 2015. Koha supports consortia, multi-branch or single-branch libraries on cloud technology. In India, most libraries are implementing Koha with the paid support of providers for services. There are ten such providers listed on Koha Community web site[22]. These provide specialised support to libraries such as data conversion, implementation, ongoing support, hosting, training, and data migration.

Informatics Publishing Limited, Bangalore has reported to have a client base of more than 50 libraries for Koha support. They have already completed more than 30 installations of Koha on cloud-based on multi-tenant SaaS model. For example Symbiosis International University, a family of 44 academic institutions, has selected multi-tenant SaaS model of Koha for its 30 libraries across India. Each of their libraries has its own rules for circulation, etc. The OPAC has more than 4,00,000 unique records which is shared by all their libraries[25]. All in-house module (acquisition, circulation, serials control, cataloguing, etc.), and OPAC has been implemented. Mysore University Library is another success story of Informatics support for cloud hosting of Koha based on Multi-tenant SaaS model. A centralised database is used with decentralised in-house activities and Open Access OPAC[26]. Informatics has also successfully completed more than 10 installations of Koha based on Single Tenant SaaS model so far.

OpenLx Technologies Pvt. Ltd., New Delhi has reported to have a client base of more than 70 libraries using Koha. They have implemented single tenant SaaS model of Koha on a central server for 18 libraries of Indian Agricultural Research Institute, (IARI), New Delhi. They also have a plan to launch Multi-tenant SaaS model of Koha this year. OpenLx also reported to have expertise in Dspace hosting on cloud and a demo version of it is available to users for evaluation and testing.

First Ray Consulting, Pune has a client base of more than 25 libraries using Koha[13]. They have implemented Multi-tenant SaaS model of Koha in 5 libraries so far. Kalptru Library, Pune selected multi-tenant SaaS model of Koha for a group of its six participating libraries. First Ray has also implemented Single Tenant SaaS model of Koha in 7 libraries. They also support libraries in providing information services from their digital collection using DSpace, and Eprints.

9.2 Proprietary ILS Software

In India, there are number of well established vendors of ILS software such as LibSys Ltd., SoftLink Asia, Algorhythms, National Informatics Centre, etc. However, only two vendors have reported to have SaaS based solutions. In this approach a substantial portion of their ILS is re-utilised and coupled with new technology in different ways to bring new services and capabilities to users. This approach is useful as designing and developing a new product from scratch is not only labour intensive but time consuming also. Todays legacy software is the hard work of many years and large investments of development and testing. Algorhythms reported that they have a plan to release a cloud version of its ILS called SLIM in June 2015.

CR2 Technologies Ltd., Ahmedabad[27] claimed to develop Asia's first SaaS based ILS solutions CYBRARIANTM, next generation ILS of LIBRARIANTM. It allows libraries to make their services online. It also facilitates indexing of all library resources in reputed search engines without compromising security. CYBRARIANTM offers all standards and protocols such as MARC21, Z39.50 with OPAC, and all in-house activities of libraries. CYBRARIANTM also provides mobile application solutions based on iPhone OS, Android OS and Windows mobile OS with latest mobile technologies including GSM, CDMA, GPRS, 3G and 4G. All mobile applications are compatible to smart phone, tablets and smart TVs. Librarian can customise CYBRARIAN™ as per their requirements including reports.

e-Granthalaya 4.0 is cloud ready version of ILS based on PaaS model by National Informatics Centre, Government of India (GOI), New Delhi[28]. The software is UNICODE compliant, thus, supports data entry in local languages. It supports a centralised database for cluster of libraries and uses PostgreSQL, an Open Source DBMS, and MS SQL server (any version of free edition) as back-end database. e-Granthalaya 4.0 can only be hosted on NIC National cloud free of cost for Government libraries on request. However, ILS version of e-Granthalaya has 3295 user base that makes the NIC largest vendor of ILS in India. They did not have any installation of e-Granthalaya

ver 4.0 so far since this was launched in Apr 2015. However, number of cloud installations is in pipeline as the ground work has already been tested and ready. NIC has a plan to host the multi-tenant model with centralised database for cluster of 20 libraries of Income-tax Department, GOI in June 2015. They have also hosted e-Granthalaya 3.0 on NIC server for 15 libraries based on single tenant model where each library has its own database.

The model offered by NIC seems to be highly cost effective as software and hosting is free. However, it is only for GOI libraries where group of libraries from an organisation will be provided a single instance of the application with central databases. Therefore, cluster of libraries will have their own instance of application and sharing a central database among them only. The idea behind this model is co-operative cataloguing and avoiding data redundancy among the holdings of libraries where same copy of a document is available with more than one library. So, all small and medium sized government libraries can feel relaxed from maintenance of hardware and software and concentrate on enhancing their library services to the satisfaction of their users.

10. DISCUSSIONS AND SUGGESTIONS

It is clear from the available information that developing an LSP from scratch using all cloud computing features is still to go a long way in India as only two vendors and three providers have cloud solution and that too based on approach where vendors include new technology with existing ILS in various ways to bring new services to users. This option is the trend presently and it seems to be more realistic.

For large single libraries, single tenant SaaS model is preferred. In this model a library is the sole owner of application and database hosted on cloud and data is not shared with anyone. In this model the cost of the application and database shall be on higher side because all cost has to be paid by one customer only. However, the data migration and security are the added advantages. The application is highly configurable. Although in this approach, application and database of each library is physically separate yet an additional database having records of all individual databases can also be maintained for providing single search facility of all library holdings. This simple solution provides additional feature in the existing application. This approach is selected by OpenLx for a group of 18 libraries of IARI, New Delhi.

Multi-tenant SaaS model is more suitable for group of libraries in a single domain. In this approach one instance of the application is shared by all participating libraries. This model is useful where all libraries agree for same features in the application. However, libraries can share their data using any of the three ways of multi-tenancy approach[8] based on the policy and agreement among the libraries. Each library is a customer having its own group of users with different circulation, acquisition policies that are configurable. This model is selected by Informatics for University of Mysore and Symbiosis group of libraries. National Informatics Centre has also selected this approach for e-Granthalaya meant for Government libraries only.

11. CONCLUSIONS

The cloud technology in libraries is still in nascent stage in India yet efforts are being made to adopt it. Numerous options should be considered before coming to a conclusion about an application, provider/vendor and model. This can only be done by setting priorities and services offered by libraries. However, there is no doubt the technology has already made an inroad but has been progressing with the desire of libraries to adopt it. However, it is felt that there is a need to evaluate the existing models adopted by libraries along with application in detail for the benefit of library community and users both. It cannot be denied that thinking about an application without mobile apps is like preferring a passenger train when mail express train is easily available.

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