

## Cloud Computing and its Applications in Libraries

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### Abstract

This paper gives an overview of cloud computing, definitions of cloud computing, features of cloud computing, services available using cloud computing and how cloud computing and its application are used in libraries. Different types of cloud computing and examples of cloud library are dealt in this paper.

**Keywords:** Cloud computing; Saas; Paas; Iaas; Hybrid cloud; Private cloud; Public cloud.

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### Introduction

Today we are living in the age of information. Information technology play a very vital role in library science. For collection, Storage, organization, processing, analysis of information. Library faces many challenges in the profession due to applications of information technology. New concepts and new technologies are being added to ease the practices in the libraries to suit the present information handling and to satisfy the needs of the knowledge society.

The emergence of e-publications, digital libraries, internet usage, web tools applications for libraries, consortium practices leads to the further developments in library profession. The latest 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.

Cloud computing: "a style of computing in which massively scalable and elastic IT-enabled capabilities are delivered as a service to external customers using Internet technologies."

### *What is Cloud Computing?*

A definition for cloud computing can be given as an emerging computer paradigm where data and services reside in massively scalable data centers in the cloud and can be accessed from any connected devices over the internet.

The terms "cloud computing" and "working in the cloud" refer to performing computer tasks using services delivered entirely over the Internet. Cloud computing is a movement away from applications needing to be installed on an individual's computer towards the applications being hosted online. (The "cloud" refers to the Internet and was inspired by technical flow charts and diagrams, which tend to use a cloud symbol to represent the Internet.)

### *Examples of Cloud Computing Services*

Web-based email services like Gmail and Hotmail deliver a cloud computing service: users can access their email "in the cloud" from any computer with a browser and

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Internet connection, regardless of what kind of hardware is on that particular computer. The emails are hosted on Google's and Microsoft's servers, rather than being stored locally on the client computer.

Over the last few years we've seen tremendous growth in cloud computing, as witnessed by the many popular Web apps used today, including: VoIP (e.g., Skype, Google Voice), social applications (e.g., Facebook, Twitter, LinkedIn), media services (e.g., Picassa, YouTube, Flickr), content distribution (e.g., BitTorrent), financial apps (e.g., Mint), and many more. Even traditional desktop software, such as Microsoft Office, has moved in part to the Web, starting with its Office 2010 Web Apps.

### Definitions

Forrester defines cloud computing as:

1. "A pool of abstracted, highly scalable, and managed compute infrastructure

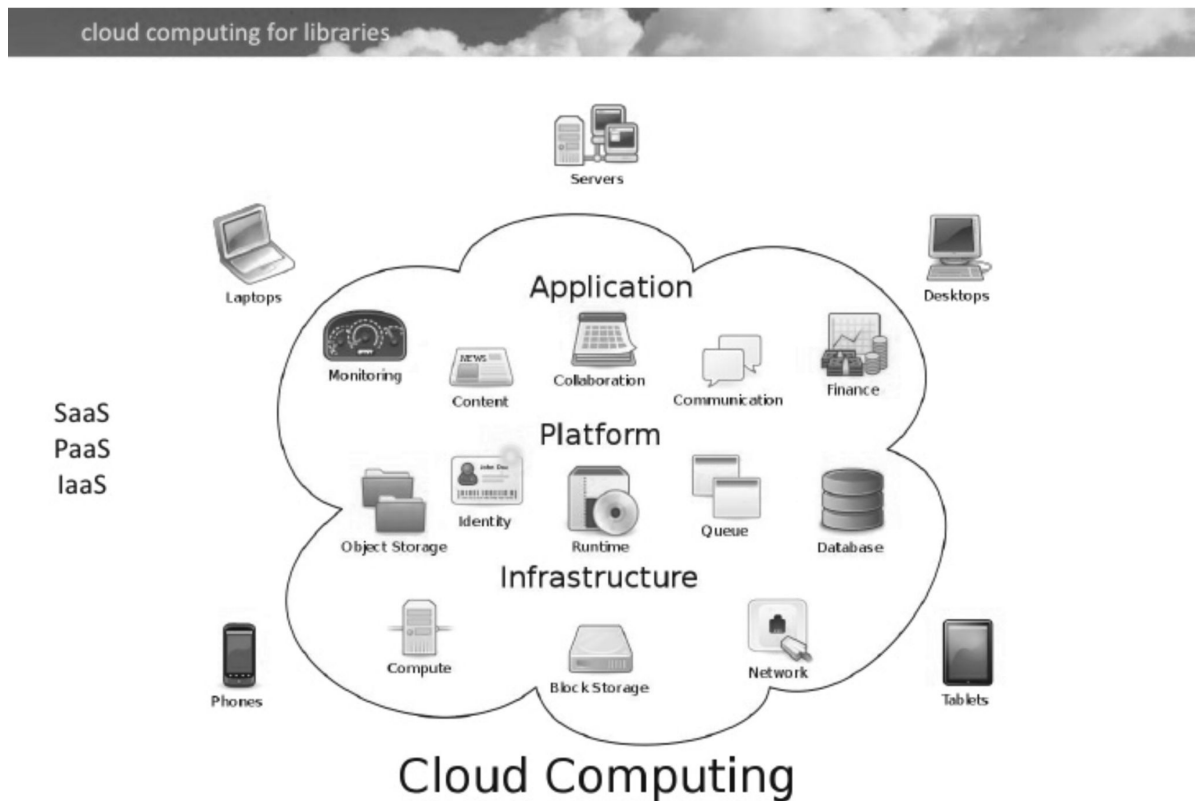
capable of hosting end customer applications and billed by consumption."

2. Berkely says "Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services."

### Features of Cloud Computing

#### 1. Self Healing

Any application or any service running in a cloud computing environment has the property of self healing. In case of failure of the application, there is always a hot backup of the application ready to take over without disruption. There are multiple copies of the same application - each copy updating itself regularly so that at times of failure there is at least one copy of the application which can take over without even the slightest change in its running state. International Journal of



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### 2. Multi-tenancy

With cloud computing, any application supports multi-tenancy - that is multiple tenants at the same instant of time. The system allows several customers to share the infrastructure allotted to them without any of them being aware of the sharing. This is done by virtualizing the servers on the available machine pool and then allotting the servers to multiple users. This is done in such a way that the privacy of the users or the security of their data is not compromised.

### 3. Linearly Scalable

Cloud computing services are linearly scalable. The system is able to break down the workloads into pieces and service it across the infrastructure. An exact idea of linear scalability can be obtained from the fact that if one server is able to process say 1000 transactions per second, then two servers can process 2000 transactions per second.

### 4. Service-oriented

Cloud computing systems are all service oriented - i.e. the systems are such that they are created out of other discrete services. Many such discrete services which are independent of each other are combined together to form this service. This allows re-use of the different services that are available and that are being created. Using the services that were just created, other such services can be created.

### 5. SLA Driven

Usually businesses have agreements on the amount of services. Scalability and availability issues cause clients to break these agreements. But cloud computing services are SLA driven such that when the system experiences peaks of load, it will automatically adjust itself so as to comply with the service-level agreements. These services will create additional instances of the applications on more servers so that the

load can be easily managed

### Cloud Computing Services

The different types of Cloud Computing services commonly referred to as Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) are explained below.

SaaS applications are designed for end-users, delivered over the web.

*Characteristics of SaaS* Like other forms of Cloud Computing, it is important to ensure that solutions sold as SaaS in fact comply with generally accepted definitions of Cloud Computing.

#### Characteristics of SaaS

- Web access to commercial software
- Software is managed from a central location
- Software delivered in a “one to many” model
- Users not required to handle software upgrades and patches
- Application Programming Interfaces (APIs) allow for integration between different pieces of software.

#### Platform as a Service

PaaS can be defined as a computing platform that allows the creation of web applications quickly and easily and without the complexity of buying and maintaining the software and infrastructure underneath it. PaaS is the set of tools and services designed to make coding and deploying those applications quick and efficient

#### Characteristics of PaaS

- Services to develop, test, deploy, host and maintain applications in the same integrated development environment. All the varying services needed to fulfill the

application development process

- Web based user interface creation tools help to create, modify, test and deploy different UI scenarios.
- Multi-tenant architecture where multiple concurrent users utilize the same development application.
- Built in scalability of deployed software including load balancing and failover.
- Integration with web services and databases via common standards.
- Support for development team collaboration - some PaaS solutions include project planning and communication tools.
- Tools to handle billing and subscription management.

#### *Infrastructure as a Service*

Infrastructure as a Service (IaaS) is a way of delivering Cloud Computing infrastructure - servers, storage, network and operating systems - as an on-demand service. Rather than purchasing servers, software, datacenter space or network equipment, clients instead buy those resources as a fully outsourced service on demand.

Generally IaaS can be obtained as public or private infrastructure or a combination of the two. "Public cloud" is considered infrastructure that consists of shared resources, deployed on a self-service basis over the Internet.

By contrast, "private cloud" is infrastructure that emulates some of Cloud Computing features, like virtualization, but does so on a private network. Additionally, some hosting providers are beginning to offer a combination of traditional dedicated hosting alongside public and/or private cloud networks. This combination approach is generally called "Hybrid Cloud".

#### *Characteristics of IaaS*

As with the two previous sections, SaaS and PaaS, IaaS is a rapidly developing field. That

said there are some core characteristics which describe what IaaS is. IaaS is generally accepted to comply with the following:

- Resources are distributed as a service
- Allows for dynamic scaling
- Has a variable cost, utility pricing model
- Generally includes multiple users on a single piece of hardware.

#### *Types of Cloud*

##### *Public Cloud*

A public cloud network enables users to distribute and access data from anywhere at any given point in time. This means that public cloud computing systems are incredibly accessible and can be shared with third parties. Based on the standard cloud computing model, in a public cloud the service provider makes its applications, storage or other resources, available to the general public. Examples of the public cloud include Amazon's EC2, Google AppEngine and Windows Azure Services Platform.

The main benefits of a public cloud service are: easy and inexpensive to set up, scalability, and a pay per what you use model (no wasted resources).

##### *Private Cloud*

Availability and distribution mediums in a private cloud network are limited only for authorized users from behind a firewall. This form of cloud computing is specifically designed for companies that do not want to distribute their internal work information to third parties. Nonetheless, these outside users can still access or distribute data provided they are authorized by the main client to do so. Private cloud computing networks are much safer to use than public ones since they require all users to be authorized.

The starting costs for implementing private cloud systems may be slightly steeper than public cloud systems, but they slowly and consistently reduce the costs once they are up and running at optimal levels.

### *Hybrid Cloud*

Hybrid cloud is developed with both public and private cloud characteristics. While public and private cloud systems are more prevalent, hybrid types have been growing in demand. Hybrid cloud systems occur when an organization provides some cloud services in-house and has others provided externally.

The advantage to this approach is that companies are able to host external data off-site with an external provider (e.g. Amazon S3), while maintaining control over internal customer data. Essentially, businesses are able to take advantage of the scalability and cost-effectiveness of the public cloud while not exposing critical information to third-parties.

With all these cloud computing systems there many benefits to businesses: large capital expenditures become a thing of the past; information can be accessed from anywhere; and time is freed up for your IT department, just to name a few. So whether you're a reseller of Microsoft Dynamics AX, Dynamics CRM or have created a proprietary system, it is time you start to ask yourself whether you should hop on board the cloud train.

#### *Advantages of cloud computing in libraries are:*

- *Cost Saving:* Cloud computing technology is paid incrementally thus saving costs for organisations. It offers price savings due to economies of scale and the fact that organizations such as libraries are only paying for the resources they actually use.
- *Easy on Installation and Maintenance:* No longer having to worry about constant server updates and other computing issues, organisations will be free to concentrate on innovation and the IT staff may concentrate on other tasks. There is no need to procure any hardware to run the servers.
- *Increased Storage:* Cloud can hold more storage than a personal computer or the servers available in the libraries or organisations and it is possible to extend as per the need.

- *Highly Automated:* The IT or library staff need not have to worry about keeping the software up-to-date. The cloud service provider takes care of updating software as and when new version is released. When the server is updated everyone using the service also get access to the new version without updating anything on their end<sup>17</sup>.
- *Flexibility:* Cloud computing offers much more flexibility than other local network computing systems and saves time plus cost for organisations. It is possible for organizations like libraries to expand the services anytime, by requesting for an additional space on the servers.
- *Better Mobility:* The staff and the users of the library can connect to the library servers from any place or from wherever they are, rather than having to remain present at their desks by having a PC and Internet access.
- *Shared Resources:* One of the important components of cloud computing is that one can share the resources. It allows people within and outside the organisations to have access to the resources. A group of libraries can come together and can put their resources at one place, which in turn will enable them to provide access to more number of resources to their end users.
- *Knowledge and Integration:* Deeper knowledge of cloud computing is essential as working of the service is totally dependent on the service provider. Similarly, integration is an issue as it will be difficult to integrate equipment used in data centers to host data with that of peripheral equipments in the organisation such as printers, USB drives, etc.

#### *Examples of Cloud Libraries*

- OCLC
- Library of Congress ( LC)
- Exlibris

- Polaris
- Scribd
- Discovery Service
- Google Docs/Google Scholar
- Worldcat
- Encore

### Conclusion

With the unlimited growth of electronic resources and technological developments, libraries are facing the serious problem of budget constraints, which was never so acute earlier; moreover users' demands are multiplying and becoming more challenging. Under these circumstances, cloud computing which is a metered utility service like mobile or electricity, where users pay for real time use, is a great ray of hope.

Cloud computing increases profitability by improving resource utilization. Costs are driven down by delivering appropriate resources only for the time those resources are needed. Cloud computing has enabled teams and organizations to streamline lengthy procurement processes. The librarian should use the modern technology to store the digital information in a wide number which can be retrieving by various users. Such technologies are Web 2.0, server virtualization, cloud computing etc... And this technology can be

used to store more information at libraries as content creation, storage, e-learning, archives etc... Data storage is the basic task of any library; hence this paper gives the clear picture of impact of cloud computing at libraries.

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