

## MOBILE CLOUD COMPUTING: ISSUES AND OPPORTUNITIES IN LIBRARIES

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### Abstract

*Emerging technologies are always attractive to libraries. Like any other service delivery organizations, libraries and librarians engage these technologies to provide services effectively and efficiently as well as making information delivery better. Most of these emerging technologies have changed the information-seeking behavior of library users and have put tremendous pressure on libraries to adopt these technologies such as Web 2.0, Web 3.0; library bookmark app, cloud computing and most recently Mobile Cloud Computing (MCC). Mobile cloud computing (MCC) was introduced to be a technology with the explosive growth of mobile applications and evolving cloud computing concept based on Infrastructure as a Service (IaaS) where both data storage and data processing operate outside of the mobile device. It is based on the concept of cloud where concentrated applications, resources, and services are accessed over the wireless network based on the web browser of the mobile phone. Despite its pervasiveness, storage capacity, scalability, reliability and, hype many libraries are yet to adopt mobile cloud computing due to various factors. Such factors are data security, privacy, failed accounts, trust, standards, organizational culture, service outage, data management, and others. Although the use of mobile devices posed a threat to library services, libraries and librarians can adopt these technologies in providing flexible, resilience and edge-cutting services to the users. This article addresses issues and functionalities, opportunities and benefits, challenges and risks of MCC. It also offers recommendations for its usage in the library.*

**Keywords:** Cloud Computing, Cloud Applications, Library Services, Mobile Cloud Computing, MCC

### Introduction

Emerging applications in Information and Communication Technology (ICT) targeted at mobile devices have reached a level where various categories of goods and service organizations such as entertainment, health, games, business, social networking, travel, and news cannot neglect. It embraces most attractive one that enhances and create a great impact on the organization as well as resulted in high productivity. Library as a service oriented organization cannot but embrace these trends to be relevant in a growing knowledge economy.

Information Communication Technologies (ICTs) have changed the way librarians think, behave, communicate, store and work. It has also allowed libraries to relegate clunky cabinets full of index cards and embrace snappy new search engines-style edges that quickly connect the users with their resources of interest. With the application of these emerging technologies in different areas of libraries, work of library and provision of services have been made easy, effective and efficient thereby providing unrestricted access to information and making the use of library more convenient for the users. With all the benefits that come with ICTs, many libraries now adopt and subscribe to technologies as they emerge. These technologies include Web 2.0 (Library 2.0), Web 3.0 (Library 3.0), library bookmark apps, web OPAC, networking of libraries, library security systems, radio frequency identification (RFID), intelligent return and sorter system. Other recent technologies are cloud computing and mobile cloud computing. These technologies are powerful with inexorable acceleration as stated by Moore's law and thus have the ability to move libraries to a better state by bringing library services to the doorstep of the users. Mobile Cloud Computing (MCC) emanated from cloud computing which makes use of mobile devices such as smartphones, tablets, PCs, and PDAs to provide different services to the users through mobile applications such as Google apps, iPhones apps, and others on their phone via wireless networks and remote servers. MCC facilitates e-commerce, e-banking, e-learning e-transportation (Uber, Taxify, O-Pay and O-Ride) and others. This technology can also be applied to the library and information centers to provide better services to users. This paper presented an overview of mobile cloud computing (MCC) in which its definitions, architecture, and challenges have been presented. The applications supported by mobile cloud computing including mobile commerce, mobile learning, and mobile healthcare have been discussed which clearly show the applicability of the mobile cloud computing to a wide range of mobile services.

### **Concept of Cloud Computing**

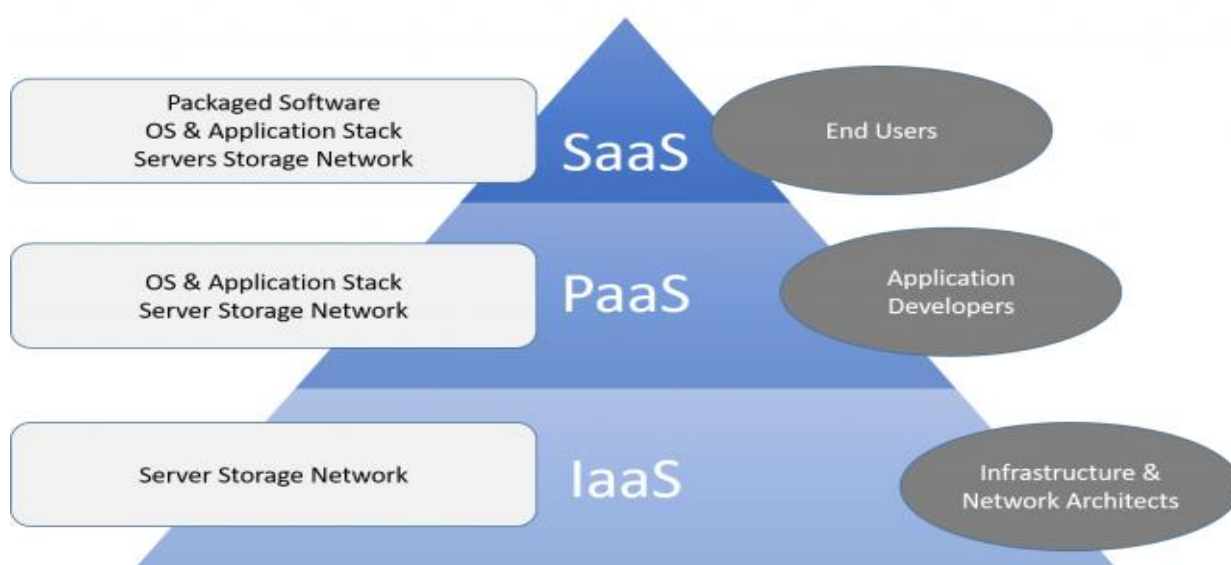
Cloud computing concept is a technology model that reduces IT complexity by leveraging the efficient pooling of on-demand, self-managed, virtual infrastructure, accessed as a service. It is considered to be one of the best ways to realize the goal of Green IT which describes the study and use of computer resources in efficient and effective ways. Cloud computing, though, a web-based computing where virtual shared resources, applications, and information are provided to the set of computers and other devices on-demand using web technology, but also transformed the way systems are built and services delivered, and also providing libraries with great opportunity to extend their impact. Cloud computing is internet-based computing where virtual shared servers provide software, applications, 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 in the Cloud without having any previous know-how on managing the resources involved.

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provided and released with minimal management effort or service provider interaction. It is a style of computing in which a pool of abstracted, massively scalable and elastic IT-enabled capabilities of hosting end-customer applications and billed by consumption are delivered as a service to clients and stakeholders using Internet technologies (Forrester, 2010 and Shaout, Borovikov and Kaja, 2014).

Cloud computing hinge on sharing computing resources rather than having local servers or personal devices to handle applications. The cloud symbol was adopted to the Internet as early

as 1994. Cloud is employed as a representation for the Internet, based on the standardized use of a cloud-like shape to denote a network on telephony schematics. Cloud computing created as a symbol is an abstraction for the complex infrastructure it contains in system diagrams and assigns remote services with a user's data, software and computation, thus the process of cloud computing is being done through a set of web-enabled applications loaded on the server with proper access rights. It allows users to use applications without installation on their local machine to access their personal and official files on any computer with internet access. Though cloud computing is not new, it is now associated with the inception of the web, allows users to access much more efficient computing by centralized storage, memory, and processing. Cloud computing is categorized into IaaS, PaaS and SaaS which also serves as layers of cloud computing system.

**1. Infrastructure as a service (IaaS):** Hardware resources and computing power are offered as services to customers. It provides basic storage and compute capabilities as standardized services over the Internet. This enables businesses to rent these resources rather than spending money to buy dedicated servers and networking equipment. AWS Rackspace, Google Compute Engine (GCE), Digital Ocean, Magento Enterprise Edition and Eucalyptus are good examples of IaaS.



Layers of Cloud Computing System: Shankar (2009)

**2. Software as a service (SaaS):** Software applications are offered as services on the Internet rather than as software packages to be purchased by individual customers. It assists the users to interact and share resources as it carries out the software services which provide access to the applications and data over the Internet anytime. Examples are Quicken online, BigCommerce, Google Apps, Salesforce, Dropbox, MailChimp, ZenDesk, DocuSign, Slack, Hubspot, social network and Wikipedia.

**3. Platform as a service (PaaS):** PaaS offers facilities to support the entire application development lifecycle including design, implementation, debugging, testing, deployment, operation and support of rich Web applications and services on the Internet. It provides an alternative to the local file system and a separate platform for cloud application developers. Examples of platforms in this category are Microsoft Azure Servicesm, AWS Elastic Beanstalk, Heroku, Force.com, OpenShift, Apache Stratos, Magento Commerce Cloud. Google App Engine, Salesforce.com, and Engine Yard. With PaaS, SaaS users can develop add-ons and standalone Web-based applications, reuse other services and work collaboratively in a team.

Mhouti, Nasseh, Erradi, and Vasquez, (2016) highlighted the five essential characteristics of cloud computing as on-demand self-service where customers can request and manage their computing resources; broad network access which allows services to be offered over the Internet or private networks with wider accessibility; resource pooling that allows customers to access a large number of resources usually in remote data centers; rapid elasticity makes services provided to be scaled and flexible or resilient in or out according to demand of users, and measured service allows users to determine and pay only for services utilized. Thus, cloud computing refers to both applications delivered as a package over the internet and the systems software in the data centers that provide services.

### **What is Mobile Cloud Computing(MCC)?**

Researchers have defined mobile cloud computing from different points of view Khan, Othman, Madani and Khan (2014) defined mobile cloud computing (MCC) to be the combination of cloud computing, mobile computing and wireless networks to bring rich computational resources to mobile users, network operators as well as cloud computing providers. According to Hirsch and Ng (2011) and Dinh, Lee, Nivato and Wang (2011) MCC is an amalgamation between cloud computing and mobile, it integrates the cloud computing into the mobile environment and overcomes obstacles related to mobile computing. Aepona (2010) described it as a new distributed computing paradigm for mobile applications whereby the storage and the data processing are migrated from the smart mobile devices to resources rich and powerful centralized computing data centers in the computational cloud. These applications are accessed over the wireless connection based on a thin native client or web browser on the mobile device.

According to Khan and Ahirwar (2011), cloud computing is not only related to personal computers, but it also affects and heavily impacts the mobile technology. Mobile cloud computing (MCC) rooted in the concept of cloud computing. It was devised in the year 2009 and incorporates cloud computing features and properties into the mobile computing environment. MCC came into being to conquer the demand of users clamoring for an increase in processing capability, the battery lifetime of mobile devices, an increase in resource sharing and removal of current limitations of the mobile devices. Mobile cloud computing becomes a concept, model and paradigm for mobile applications whereby processing and data storage is moved from the mobile device to computing platforms in the cloud (Sharma and Bohra, 2015). The technology leverages unified elastic resources of varied clouds and network technologies toward unrestricted functionality, storage, and mobility. It serves as large number of mobile devices simultaneously through the channel of Ethernet or Internet regardless of heterogeneous environments and platforms based on the pay-as-you-use principles (Sanaei, Abolfazli, Gani, and Shiraz, 2012). It often involves three foundations namely cloud computing, mobile computing, and networking, and can be considered as an emerging cloud service model following the trend to extend the cloud to the edge of networks.

MCC avails mobile users and organizations the opportunity to circuit business applications without a large amount of capital investment in infrastructure and services. Christensen (2009) presents general requirements, key technologies and introduced an analysis of cloud computing on smartphones, and web-based services, and explains how these components can interact to create a better experience for mobile phone users, while Luo (2009) introduces the idea of using cloud computing to enhance the capabilities of mobile devices which resulted into using the cloud to back mobile computing. Chun and Maniatis (2009) and Kovachev (2010) introduced different approaches to offloading blocks from mobile device to the cloud-based on resources available and elasticity of an application on the device, which enables component offloading

to cloud and vice versa at any particular time to enhance the execution performance of a mobile device, and thus brings better results in terms of energy and performance.

### **Issues and Functionalities**

The development of mobile technology and wireless networks is rapidly growing, and they are initially used for dialing and receiving calls and writing messages, but now, they are capable of doing every functions being performed by the computer system. Smartphones and other mobile devices have become multipurpose tools capable of handling functionalities performed by the computer system using a wide range of applications.

According to Chang, Bacigalupo, Wills, and De Roure, (2010) mobile cloud computing has the following characteristics; storage and sharing, universal accessibility, collaborative interactions and learner-centered which add knowledge to interested and willing users. Cloud computing is cost-effective, the initial expense and recurring expenses are much lower than traditional computing. Cloud computing is characterized by features such as platform, location, and device independence, which make it easily adaptable for all sizes of businesses, in particular small and mid-sized. Cloud computing also brings an array of new features compared to any other computing paradigms there are Scalability and On-Demand Services, Quality of Service (QoS), User-Centric Interface, Autonomous System and Pricing.

The cloud computing provides all the basic services to these mobile devices at the backend as great number of cloud applications has been in the market like one drive by Microsoft, Google drive by Google and cloud by apple. This applications drives a strong demand for mobile cloud applications and services for users, hence brings out a great business and research opportunity in mobile cloud computing (MCC).

### **Services and Model of MCC**

With cloud computing, hardware and functionality traditionally installed and run in a local environment is now performed on the network, in the Internet cloud. In essence, the Internet cloud becomes the development platform and the operating system to which programmers write reusable, constantly updated software components that are delivered over the network and that can be embedded or loosely coupled with other Web applications. The main objective of mobile cloud computing is to provide mobility so that users can access resources through wireless technology from anywhere they are (Bheda and Lakhani, 2013). It is also to deliver location-aware mobile service with mobility to users based on scalable mobile cloud resources in networks, computer storage and mobile devices. According to Chang, Gruhn, Gao, George and Tsai (2013), the primary goal is to deliver them with secure mobile cloud resources, service applications and data using energy-efficient mobile cloud resources in a pay-as-you-use model.

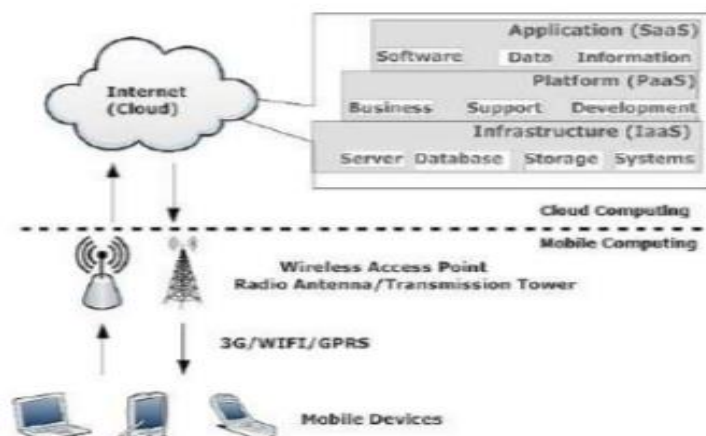
It has been proved that cloud computing features is similar to mobile cloud computing which include scalability, multi-tenancy, virtualization, mobile cybersecurity and user privacy, auto resources provision and management and many more. The benefits of MCC to organizations and enterprises is overwhelming because it improves the development, reduce execution cost of mobile applications, and mobile users are enabled to acquire new technology as an on-demand basis Mobile cloud computing is differentiated from mobile computing in general because the devices run cloud-based Web apps rather than native apps.



- Cloud Computing

- Mobile Network

- Mobile Device  
(with developed Application )



(Source: Qureshi, Ahmad, Rafique and Shuja-ul-Aslam, 2011)

Similar to three service models of cloud computing (SaaS, PaaS, IaaS), primary service models of MCC are listed as follows:

1. **Mobile Network-as-a-Service (MNaaS):** This model provides mobile network to the customer's on-demand basis. Using this model, customers enjoy their logically segregated networks. They can pay for more network only if required.
2. **Mobile Cloud Infrastructure-as-a-Service (MIaaS):** Various computing and storage resources, virtual servers and other components are provided to the mobile clients on rent basis. Mobile clients are responsible for building and deploying mobile applications as well as for the other middleware technology.
3. **Mobile Data-as-a-Service (MDaaS):** Using cloud database technology, this model provides mobile data stores and other storage resources to the users.
4. **Mobile Platform-as-a-Service (MPaaS):** In this model, the mobile platform (IDE) is provided to the customers. Clients are responsible for the whole application development and deployment. Mobile Software-as-a-Service (MSaaS): Mobile software (app) is provided to the user in an online as well as offline manner. Users are responsible for running and accessing those apps using a thin mobile client.

### The Relevance of MCC to Library Services

Many changes have been introduced to libraries ever since the evolution of libraries in accordance with the Raganathan's fifth principle of the library: the library is a growing organism and, Moore's law to meet the growing and changing needs of library users. CC is used to shape a digital library and to automate housekeeping operations using third-party services, both software, and hardware. CC allows libraries to put maximum contents in the cloud thus allowing users to access the contents easily on mobile devices. Physical books and other documents can be scanned into a searchable database and made accessible to library users. Libraries with digital collections and electronic resources move such contents to the cloud and this gives users increased capacity and less need for updates and maintenance. MCC remains a better platform for libraries to be relevant in emerging technologies in providing service to teaming young population of library users who prefer using or glued to mobile devices.

To overcome bottlenecks of server access restriction and complexity, libraries should embark on implementation of MCC and obtained high computing power, greater sharing of information resources and easy updates of information and technologies to library services.

### **Opportunities and Benefits of Mobile Cloud Computing in Libraries**

Today we are living in the knowledge age where information technology plays a very vital role in handling library resources ranging from the collection, storage, organization, processing, dissemination, accessing and analysis of information dissemination.

Librarianship is facing many challenges due to applications of trending information technologies, though technologies are being added to ease the practices in the libraries and satisfy the needs of the knowledge society. With the application of information technologies, library automation, digital library, internet usage, online literature searching, web tools application for libraries, consortium practices have become necessary tools for effective library service delivery.

CC allows libraries to move the processing effort from the local devices to data center facilities. With the tremendous advantages of cloud computing, it is expected that technology will revolutionize the field of library and information service. Mobile cloud computing applications provide flexibility not only for organizations but also for educational institutions and libraries. With regard to MCC; services, applications and data are stored on multiple servers that can be accessed through the Internet, but in traditional web-based service mode there exist a lot of problems, cloud computing has many advantages such as expected performance, reduced upfront investment, high availability, reduced launching time, infinite scalability, tremendous fault tolerance capability, and accessibility, enhanced collaboration, and mobility, allow users to use any device, such as a mobile phone, personal computer (PC) etc. Many hitches are encountered in services delivery such as high device and network costs, low network transmission rates, big data and proliferation of information resources. Combining the advantages of mobile and cloud computing, MCC was introduced to solve these limitations in providing better access, more control, and greater freedom for users (Weber, 2011; Kitanov and Davcev, 2012).

Cloud computing allows libraries to leverage MCC to their advantage making it easy for libraries to host their application on the internet and provide speedy library services to the users. Several solutions have been proposed to enhance the central processing unit performance and to manage the disk and screen in an intelligent manner as well as reducing power consumption of battery. Extension of battery lifetime becomes the major concerns of mobile devices, hence, configuration of the mobile devices thus consumption offloading method came up to move big and enormous processing from mobile devices to the server in the cloud. Mobile cloud computing create a way to store and back up data and application on many computers, this reduces and prevent data loss on the mobile devices, thus improving the accuracy and reliability of storing and retrieving data on the cloud.

MCC has eliminated the impulsion of the storage capacity of mobile devices. It gives room for mobile phone users to store large data in the cloud and help to reduce the running cost for compute-intensive applications that take a long time and a large amount of energy when performed on the limited resources device. MCC also gives room for many library services to be integrated easily through the cloud to meet the demand of the users (Dinh, Lee, Niyato and Wang, 2011).

Mobile cloud computing offers unlimited mobile connectivity to mobile cloud infrastructures, apps, stores, and cloud-based applications. It also enables virtualization of wireless networks, mobiles devices and connectivity to existing cloud infrastructure and technologies. (Chang, Gao, Gruhn, George and Tsai, 2013).

Apart from the general benefits of MCC, there are also specific benefits of MCC to the libraries, users and library personnel. Mobile cloud computing allows the users to access library services anywhere, anytime and reduces IT infrastructure and ongoing IT costs thus saves time and energy of the users. MCC allows the users to place a reserve on information materials needed online, also emails alert, book updates, payment can be made on MCC by the users. It also allows users to have access to databases using IP, institutional repositories, free resources, e-learning, and training materials question papers and archives uploading. Users also have the opportunity to connect to other library users in other library throughout the world and share information. Every library requires a big server and hard-wired internal network to operate efficiently but with tremendous benefits of MCC, hardware requirements are substantially reduced and only internet connection is needed. Consequently, libraries won't have to invest in unnecessary computing power and networking nor will they be saddled with expensive contract support, therefore, it reduces operational cost.

MCC requires less time updating applications on the mobile devices, almost 100% uptime isn't uncommon and that enables the library to enjoy best capability and benefit, cloud provider offers the library without lengthy, disruptive update routines. In addition, MCC provides very high-level data protection especially for sensitive data that include user information. The data is kept in a centralized data storage that can only be accessed through strict authentication methods. Also, allow the library to recover data from the cloud by following a certain process in case of a disaster. MCC libraries will be able to provide new services to the users and develop strategies to provide 24/7 services. MCC will also allow the library to advertise other programs e.g library tour, orientation, information literacy program, online literature search organize for users that will be taking place in the library.

MCC enables librarians and para-professional staff members to work more efficiently by freeing them from a fixed terminals place. Services like check-in and check-out of books or information materials can be managed from the portable tablet and the speed with which information can be accessed enable library personnel to spend few times with different users to deliver great services. With mobile cloud computing, library personnel can work from anywhere, even at home where the application can be assessed securely via mobile devices, thus the world becomes the offices and give more productive result.

Mobile cloud technology gives room for staff collaboration because implementation of policy or strategies to make library staff more responsive is made easier. It frees the library personnel confines to the circulation desk to give quicker and more personalized services thus reduces downtime and keep the user happy and willing to return in the future. There is room for online attendant monitoring, users record maintenance, fine connection by the library personnel on mobile cloud computing. Library personnel will have the opportunity to share up-to-date resources, new arrivals and forth coming events with the user. It improves the library personnel skills and broadens their scope of knowledge, literacy and skills when it comes to the use of computers in the library. MCC library personnel can order books and other information materials needed by the library from book vendors and publishers.

### **Risks and Challenges of Mobile Cloud Computing**

Mobile cloud computing is facing many risks and challenges apart from the basics challenges of cloud computing. MCC has opened another era of bringing IT services in many areas ranging from education, healthcare, entertainment, business and social networks, this is due to utilization of high computing power providing unlimited access, on-demand and 24-hour



continuous service delivery for mobile users. The main goal of mobile cloud computing is to provide users a convenient and quick way to access the data from the cloud on the go by using their mobile devices. While enhancing the user's convenience, there are still some challenges which include:

1. **Service from Network Provider/ Signal Disturbance:** Mobile cloud depends on the wireless connection, the inability of service provider to provide adequate and effective services for users to connect to the internet post a risk or threat to mobile MCC. Break down of network, no network coverage, transportation crowding, low-frequency signal and many more affect the reliability access speed and storage facility when accessing library services. The quality of the mobile networks might not be adequate for delivering satisfactory user experience via the collaboration between mobile devices and cloud services (Hung, Shih, Shieh, Lee, and Huang, 2012).
2. **Loss of the battery and network:** Mobile devices are less powerful and consume more energy. MCC increases battery usage because the size of altered code is small thus limited energy source is produced.
3. **Low Bandwidth:** MCC uses radio wave which is limited as compared to wired networks; the wavelength is distributed in different mobile devices which made the bandwidth three times slower in access speed as compared with the wired network.
4. **Division of Application Services:** Mobile devices have few resources, application are shared in other to reach a goal performance target which is fast in response time and low data transfer.
5. **Privacy and Security:** It is very hard to control maltreats such as viruses, worms, Trojan horses on mobile devices. Also, mobile devices have a global positioning system (GPS) that cause privacy issues for mobile users. Dinh, Lee, Niyato, and Wang, (2011) and Hung, Shih, Shieh, Lee, and Huang, (2012) emphasized the users' profound information and their privacy can be easily desecrated when cloud providers utilize user data for claimed purposes.
6. **Control of applications:** Information sources are stored on the cloud and computations are performed on the cloud; clients are no longer in full control of applications (Hung, Shih, Shieh, Lee, and Huang, 2012).
7. **Enhancing the Efficiency of Data Access:** The request of accessing data resources on the cloud has increased thus, cloud provider finds it difficult to tackle the provided store, manage and access in the computation. In addition to the above-mentioned points, MCC is also affected by context-aware mobile cloud service, handoff delay, limited power, and low computing ability.
8. **Limitations of the hand-held devices:** Mobile devices reduce the processing capability, memory and bandwidth comparing to PCs and laptops. They are more resource constraints than PCs and laptops. Though mobile devices have improved tremendously, nevertheless in terms of storage, size of the screen, the capability of CPU, wireless communication, operating systems, computing capability and energy resource to set up complex applications mobile resources are still lagging behind.
9. **Problem of individualization of mobile devices:** There is proliferation of handheld operating systems and to develop an application based on the handheld device, user's end of the application software must be simple. Simple client end means that a large amount of data computing can be put in the cloud end and the client-side be made standard so that it can run on any mobile device, without making much modification.
10. **Quality of service:** Data transfer rate in a mobile cloud computing environment is ever-changing and the connection is discontinuous since the Internet service provider is normally far away from the mobile device users. Dynamic alteration of application throughput, mobility of users and even weather leads to variations in bandwidth and network overlap.

Mobile cloud computing has increased the scope of library services, it has several benefits to both the content providers and libraries. It is cost effective for libraries and service provider, libraries don't need to constantly maintain and upgrade hardware or software. Computing maintenance, storage, and updates are completed on the cloud side, mobile devices serve for display only (Mohamudally, 2011). There is a good number of cloud computing initiatives undertaken by provider such as Amazon web services, Google Apps, Microsoft windows Azure and others offering various types of cloud computing services for organisations, businesses, and individuals. Libraries can successfully use the followings on MCC; OCLC web scale, Ex-Libris cloud, Duraspace's DuraCloud, Moodle for LMS, Open source software like Koha, Dspace, Greenstone, Hydra and Samvera and Content management software like Drupal and Joomla

As a result, users can utilize web-based applications on their mobile devices with small memory spaces because there is no need for software loading and document saving. They can use variable mobile devices to access information and book content without purchasing, installing, or updating any software (Rao, Sasidhar, and Kumar, 2010). Library services can be easily accessed as long as mobile network is available. According to Palmer and Dodson (2011) and Rao, Sasidhar, and Kumar, (2010) users can have access to many content easily via 3G and 4G mobile technologies using services from the cloud data center over their mobile phones in a small village or remote areas without high-speed broadband Internet connections.

Since information resources stored in clouds are shared across different libraries, more resources are available for mobile cloud users. Many innovative applications and services, which improve collaboration, Lending services, Union/Shared Catalogue/OPAC, Selective Dissemination Information (SDI), Current Awareness Services (CAS), ILL, bulletin board services, document and file sharing, collection development, information literacy/orientation, social interaction with the users and information discovery, can be implemented (Hirsch and Ng, 2011).

## **Conclusion**

Technologies are shaping our world today, revolutionizing the way we live, learn and acquire knowledge. Mobile cloud computing is one of the mobile technologies that shows the applicability to many services, though in the initial stage, trends in the future. MCC, though complex and moving landscape, supports libraries and many service organizations that provide services to individual and procure the documents and information resources. MCC leverages the elastic resources of web tools and wide-ranging clouds toward flexibility and functionality in order to provide unrestricted access to mobile devices users anywhere and anytime. Despite its functionalities, security and privacy still remain the major issues facing many libraries though many strategies have been put in place by service providers to achieve the goals of availability, confidentiality, data integrity, data control as well as audit. In mobile cloud platform, libraries can offer a range of product which includes outsourcing of library documents and services through internet, delivery of services as well as documents as a utility, just-in-time on-demand library services and inter-library loan (ILL), cooperative digital reference services, current awareness services and selective dissemination of information services through emails and blogs, shared hardware, services, web-based archiving and mobile cloud OPAC services.

## **Recommendations**

Libraries, the epicenter of knowledge, should be explore, build and promote the use of emerging technologies for better and efficient services delivery to users. They should continuously improve by adopting many new IT technologies and make cloud-based

services as a reliable medium to disseminate library services to users with ease of use and constancy.

MCC service provider needs to address issues pertaining to privacy, data security, network security, data access, data confidentiality, data breach issues and other security threats to achieve a secure MCC environment.

There is need to embrace MCC and allied technologies in libraries to meet users' demand and provide quality service at anytime and anywhere. To this end, libraries must provide adequate funds and necessary equipment in addition to maintenance strategies. Training of personnel is also imperative since the implementation calls for concerted effort of librarians, management and the parent body. Finally, libraries should ensure a long term adaptability and sustainability of MCC.

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