MOBILE CLOUD COMPUTING: SURVEY AND ITS IMPACT ON E-LEARNING

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***Abstract*— Mobile cloud computing(MCC) , the combination of mobile computing and cloud computing, is a rapid technology boost in this modern time because of the revolutionary growth in mobile computing, multimedia communication, and wireless technology. As in these few years, the popularity of the mobile device has grown rapidly due to its development in real-time applications like facetime, social media applications, online gaming but still leak in many areas. MCC overcomes these opportunities and issues related to this environment (such as battery life, storage capacity, Processing capacity, Security, heterogeneity, scalability).MCC is an adaptable technology for most organizations with dynamic scalability and utilization for virtualized resources as a service over the internet. Several researchers confirm that MCC is a good way to overcome the disadvantages and limitations associated with the traditional way of**
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E-Learning as it provides easily accessible and affordable resources over the internet. In this paper, we will explain the combination of cloud computing and mobile devices and how it takes
E-Learning one step ahead in the future.

Keywords: mobile computing, wireless networks, data management, distributed systems.
CR: C1.4 (Mobile processors), C2.1 (Wireless communication), C2.4 (Distributed systems).

INTRODUCTION

In the current world, millions of people are connected to each other doing business, ordering food & groceries online, attending online classes(m-learning) on their hand-held Mobile devices (i.e. Smartphones, Tablets, and PDAs) provide them with access to many important pieces of information just by one touch and a stable internet connection. The technology that makes all this possible is known as Mobile Cloud Computing (MCC).

Cloud computing provides on-demand, scalable, device-independent, and reliable services to its users. The aim of mobile cloud computing
(MCC) is to use cloud computing techniques for the storage and processing of data on mobile devices, and hence to reduce their limitations. The term MCC was introduced just after the concept of cloud computing that was launched in mid-2007. Since then, it has been drawing the attention of organizations to reduce the development cost of mobile applications. It provides mobile users and researchers with a variety of mobile services at a low cost.

Meanwhile, smartphones are considered as the representative for the various mobile devices as they have been connected to the Internet with the rapidly growing wireless network technology. Ubiquity and mobility are two major features in the next-generation network which provides a range of personalized network services through numerous network terminals and modes of access. The core technology of cloud computing is centralizing computing, services, and specific applications as a utility to be sold like water, gas, or electricity to users. Thus, the combination of a ubiquitous mobile network and cloud computing generates a new computing model, namely Mobile Cloud Computing. As an inheritance and development of cloud computing, resources in mobile cloud computing networks are virtualized and assigned in a group of numerous distributed computers rather than in traditional local computers or servers and are provided to mobile devices such as smartphones, portable terminals, and so on. (see Fig. 1). Meanwhile, various applications based on mobile cloud computing have been developed and served to users, such as Google's Gmail, Maps and Navigation systems for Mobile, Voice Search, and some applications on an Android platform, MobileMe from Apple, Live Mesh from Microsoft, and Moto Blur from Motorola. According to the research from Juniper, the cloud computing-based mobile software and application are expected to rise 88% annually from 2009 to 2014, and such growth may create

US 9.5 billion dollars in 2014.[1]

LITERATURE REVIEW

MCC Overview:

A. Architecture of Mobile Cloud Computing :
The architecture of Mobile cloud computing comprises five components such as the Internet, Cloud, Access point, Mobile device, and Mobile Network Services [16].

1) Mobile Devices: The end-user or consumer uses various types of mobile devices such as Smart Mobile, Personal Device Assistance, Tablet, and E-Readers. These devices access the cloud services in two ways. The first way is through Mobile Network Services and the other way is through Access point. Both ways use the Internet as a medium to access Cloud services. In the first way, the mobile devices connect to Mobile Network Services via base stations and in another way, mobile devices connect to access points via Wi-Fi.

2) Mobile Network Services: Mobile network operators work as Mobile Network services providers. By using base stations or satellite links, mobile devices access the cloud.

3) Access Point: Instead of using Network Operator, mobile devices connect to the internet via Wi-Fi. The mobile devices access the cloud with less latency and consume less energy. The mobile cloud customers use Wi-Fi whenever possible

4) Internet: This component is very important in Mobile Cloud Computing Architecture because it works as a medium between mobile devices and the cloud.

B. Different models of Mobile Cloud Computing:

According to Muhammad Baqer Mollah there are six service models, they are:
1) Mobile Network as a Service: In this service model, the cloud service providers provides the Network Infrastructure. The consumer can build their own network and control the traffic and access the servers. Open stack platform is the best example of this model.

2) Mobile Cloud Infrastructure as a Service: In this service model, service providers provide mobile users with cloud components and storage. Samsung Cloud, iCloud, and Google
Drive are the examples.

3) Mobile Data as a Service: This model provides the Databases and management tools to the end-user. The end-user can access the data, upload the data and change the data.CloudDB is the best example for this model.

4) Mobile App as a Service: In this model, the service providers provide various applications over the cloud for the end-user. The end-user can install and use the application by using the Internet. Installing applications from the Google play store is the best example.

5) Mobile Multimedia as a Service: In this model, the end-user can play video, audio, and games over the Internet. Netflix, Amazon Prime, and online gaming mobile websites are the best examples.

6) Mobile Community as a Service: This service model is maintained by a community over the internet to provide services to the end-users. One Plus mobile community is the best example.

The architecture of Mobile Cloud Computing

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METHODOLOGY

Cloud Computing & Mobile Cloud Computing Comparison :

This particular section covers the comparison of mobile cloud computing and cloud computing like the difference between advantages, applications, problems, service models.

> *Comparison of service model between Cloud Computing and Mobile Cloud Computing:*

Cloud Computing basically consists of 3 service models whereas Mobile cloud computing has 6 service models

> *Comparison related to the problem:*

Cloud Computing	**Mobile Cloud Computing**
• Automated service provisioning • Migration problem of Virtual Machine • Server Consolidation. • Management of Energy. • Analysis and Management of Traffic • Software Frameworks. • Security of the Data. • Novel Cloud Architecture.	• Problems on Operational level. • Problems on the end-user level. • Problems on service and application levels • Security and Privacy problems • Awareness problem • Problems with Data management

Both Cloud and Mobile Cloud computing have issues to overcome.

E-LEARNING AND M-LEARNING

A. Context: E-learning is a distance learning mode based on new multimedia technologies and the Internet, which allows one or more persons to form from their computer. Multimedia materials used can combine text, graphics, sound, image, animation, and even video [4]. Many researchers consider m-learning just as a natural evolution of e-learning, which completes a missing piece of the solution while leveraging the main strength of mobile ICT, or as a new stage of distance learning (dlearning) and e-learning [5]. Historically, d-learning has over a hundred years of experience and tradition. Its main feature is the separation in time and space, the learner and the teacher. eLearning provides new distance learning methods based on information technology and the Internet. The other side of the m-learning is part of the e-learning and, therefore, a portion of d-learning as shown in Fig 1.

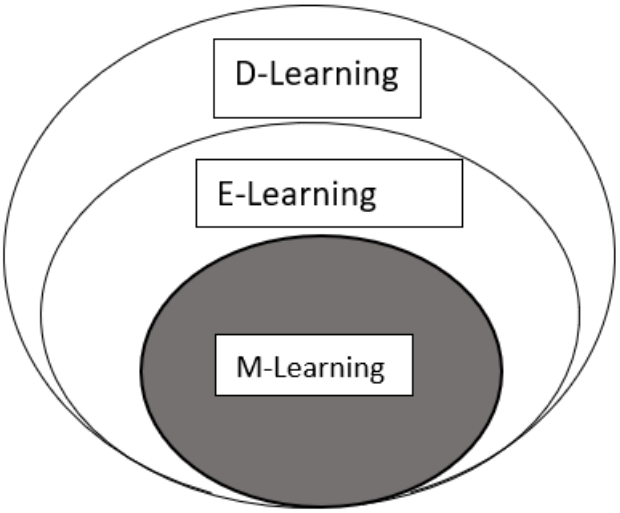

Figure 1. The positioning of m-Learning as part of the e-Learning and d-Learning

B. Service Models: Cloud services, illustrated in Figure 2, are generally based on three layers [3]:

- Data center layer provides the necessary equipment and infrastructure clouds. In this layer, there are a number of servers connected to broadband networks. Data centers are often located in places with the ability to power high voltage and away from all dangers.

- IaaS (Infrastructure as a Service) forms the base of the cloud. These servers, storage, databases, and network equipment are leased as demand services with levels of adjustable services.

PaaS (Platform as a Service) is a runtime platform hosted by an operator connected to the Internet. It allows you to run software in SaaS mode. For years, Amazon, Google, and others have offered PaaS solutions at competitive prices.

SaaS (Software as a Service) is an application provided as a service. Users access it via a connection to the internet.
The architectureof Service-Oriented Cloud Computing.

C. Deployment Models: There are three forms of deployment of Mobile Cloud Computing [8]:
Private Cloud: If the cloud infrastructure is used by a single company, the cloud is privately said.

- Public Cloud: In case some large companies can exploit large internet data centers, making them accessible to everyone. The most reputable companies offering this service are Google, Amazon, and Microsoft.

- Hybrid Cloud: A hybrid cloud is a case of a combination of at least two types of Cloud above.

D. Architecture of Mobile Cloud Computing: The general architecture of MCC can be shown in Figure 3 [3].
Mobile devices are connected to mobile networks via base stations (BTS, access points, or satellites) that establish and control the connections and functional interfaces between networks and mobile devices. Applications and mobile user information is transmitted to the central processors that are connected to servers providing mobile network services. Here, mobile operators can provide services to mobile users as AAA (Authentication, Authorization, Accounting) based on the home agent (Home Agent: HA) and data stored in the subscriber database. After that, requests for the subscribers are delivered in the cloud through the Internet. In the cloud, controllers handle applications to provide mobile users with the corresponding cloud computing services. These services are developed with the concept of utility computing, virtualization, and service-oriented architecture.

INFRASTRUCTURE

M-LEARNING WORKS ON MCC

A. m-Learning architecture based on the Cloud: The main objective of M-Learning in the cloud environment is to provide learners with the resources centralized shared knowledge anytime and anywhere. An architecture that has been proposed for m-learning as shown in Figure 1 includes the communication between the end-user device (terminal) and the data center into a cloud environment [2]. The terminals can be connected to the infrastructure within the local network of the University (LAN: Local Area Network), or they can be connected to external networks (Internet). The platform of the university server (Course Management System) [4] hosts educational resources via the university LAN. A user can access the platform directly from the university LAN or across the
Internet to gather learning materials.

BENEFITS OF USING THE M-LEARNING BASED *MOBILE CLOUD COMPUTING*

M-learning can use and benefit from mobile cloud computing using:

- IaaS: use a solution of m-learning on the provider's infrastructure.

- PaaS: use and develop a solution of m-learning based on the supplier's development interface.

- SaaS: Using the m-learning solution provided by the provider. There are many benefits when the m-learning is implemented with MCC technology, namely [4]:

- Low cost: The m-learning users should not have cell phones upscale with a good configuration to run the m-learning applications. They can run cloud applications through their mobile phones with a minimum configuration with Internet connectivity.

- Improved performance: Since m-learning applications based on the MCC run on the cloud, mobile client laptops perform better because they have fewer memory loaded programs
and processes

- Updates instant software: Because applications are in the cloud, updates occur automatically and are available once learners are connected to the cloud.

- Improved document format compatibility: In the MCC, we have more compatibility to open files and applications easily without installing more

software on mobile devices seen as m-learning based on the MCC opens files via the cloud.

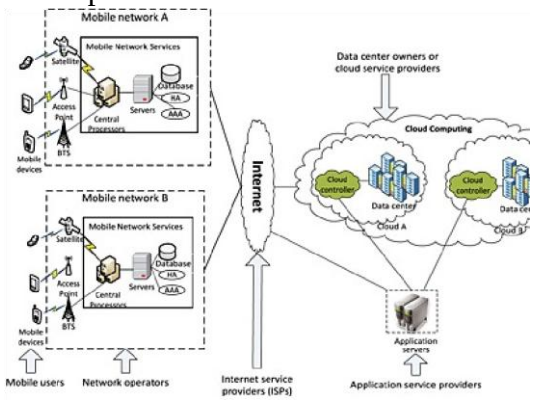

Figure 3. Mobile Cloud Computing (MCC), architecture [3]

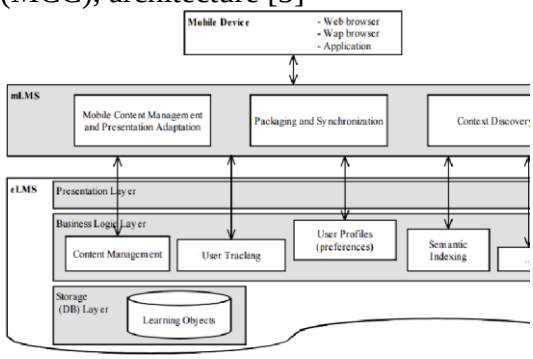

Figure 4. general and generic architecture of m-learning [9]

- Benefits for students: Students get more benefits through m-learning based on the MCC. They can take online courses, participate in online examinations, obtain feedback from the course instructors, and send their online projects to their teachers.

- Benefits for teachers: Teachers also get many benefits via m-learning based on the MCC. Teachers are able to prepare for online tests for students, process and create better content resources for students through content management, evaluate the tests, homework, projects, followed by students, post comments, and communicate with students through online forums.

CONCLUSION

This paper provides an overview of concepts, achievements, research issues and challenges in mobile computing. Mobile computing, as it stands today, offers many exciting opportunities. However, the challenges that the research community faces are quite significant. These challenges include mobility aspects, power, frequent connections/disconnections, bandwidth limitations, cost factors, resource scheduling and management, advanced concurrency, replication and synchronisation algorithms.

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