Mobile Cloud Computing: Security Levels, Challenges and Applications

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Abstract— Due to the advancement of mobile technology and its low cost, mobile telephony has been penetrated at large level. Smartphone users are growing with a rapid pace and the number of new research dimension has been emerged in mobile computing. Mobile Cloud Computing (MCC) is one of the burning areas of research in computer science. it is basically the combination of cloud computing and mobile computing. Availability of high speed internet and enhancement in the battery life of mobile devices, the usage of internet over mobile phone has been increased. In this study, a brief definition of cloud computing, mobile computing and mobile cloud computing is presented. After that a deliberated discussions on MCC architecture, different security levels, and challenges of MCC are covered. At last some applications are discussed where MCC is commonly used.

Keywords— *Cloud Computing, Mobile Computing, Mobile Cloud Computing, Security and Challenges of MCC*

I. INTRODUCTION

Mobile devices such as smartphones, PDAs, tablets etc. are becoming the integral part of our in daily life. To make human life easy there were lot of improvement has been done in software as well as hardware technology. Today, computing is based on Internet and the demand of internet based computing is increasing day by day. Mobile Cloud Computing (MCC) is an important platform for computing and it is projected with cloud computing and mobility[1]. It is formally defined as "the combination of cloud computing and mobile computing". The resources on the cloud is accessed through mobile devices and it is also called remote server based computing. Another definition of MCC[2] referred as "an infrastructure where both the data storage and data processing happen outside the mobile device". It gives two benefits first, it is efficient computing power and storage of data would outside mobile device that will be increased the maximum power utilization and maximum storage in mobile device.

In this paper, we survey different security levels which are important for Mobile cloud computing., MCC provides at three level of security such as mobile cloud level, mobile network security level and mobile terminal. The details of security levels is discussed in next section. Challenges for MCC are also very important , therefore various challenges MCC may faced are discussed in detail. At last, the applications part of MCC in real applications such as mobile healthcare, mobile learning and mobile commerce etc. are briefly explained.

The rest of this paper is organized as follows. Section II, we provide an overview of cloud computing , mobile computing and mobile cloud computing. In section III, we discuss various security levels issues and the section IV discusses the various major challenges of MCC. The various applications of MCC provide in section V. Finally, the section VI concludes the review paper.

II. Mobile Cloud Computing (MCC).

The evolution of mobile cloud computing (MCC) has invented and inherited from cloud computing, which was started in 2007. It is the combination of cloud computing and mobile computing. It is the enhancement of cloud computing while using mobile computing environment. This new computing era is in continuous progress since 2009 and has been adapted in many fields [1] such as business model, Google's Gmail, Map and Navigation systems for mobile, Voice search etc. The major objectives of MCC is to improve and make communication faster , saving of power and storage on it.
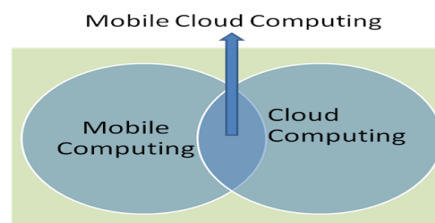

Figure1. Origin of Mobile Cloud Computing [3]

The definition is given by MCC forum as follows [4]:

Mobile cloud computing at its simplest, refers to an infrastructure where both the data storage and data processing happen outside of the mobile device. Mobile cloud applications move the computing power and data storage away from mobile phones and into the cloud, bringing applications and MC to not just smartphone users but a much broader range of mobile subscriber'.

Aepona[5] defined MCC as '*new paradigm for mobile applications whereby the data processing and storage are moved from the mobile device to powerful and centralized computing platform located in clouds.'*

The cloud computing is defined as "combination of virtualization and different computing resources that can be used by end user as per their requirement". This requirements are followed a principle i.e. pay per uses basis [6] computing resources.

Mobile computing is a mechanism to transmission [7] of data to and from one mobile device to another devices and compute within the mobile devices. When mobile and computing combined into a single unit it is also known as mobile computing.
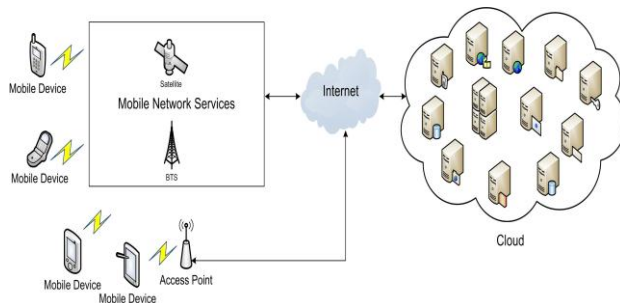

Figure 2. Mobile Cloud Computing Architecture [8].

Mobile cloud computing architecture [8] having five components including *Mobile devices, Mobile Network Services, Access point, Internet and Cloud.* The mobile devices can access the cloud service via Internet by using either Mobile Network Service or Access Point as shown in the figure 2. Mobile Network service is also called as telecom network provider. The mobile devices such as cellular or Smartphone are accessing cloud service using mobile network which is linked via Base Station (BS) or a Satellite. Here, external satellite links are also used in case the mobile device is not connected with a satellite .Then after it is connected to the Internet and which is available for users. Another way to connect the mobile users to the access point is through Wi-Fi when connected to the Internet Service. The major benefits of using Wi-Fi connection over 3G/4G connection are low latency and also consumed less energy.

III.SECURITY ISSUES IN MCC

The security issues are the biggest challenges in Mobile Cloud Computing Environment, there are various level of securities discussed in [9].
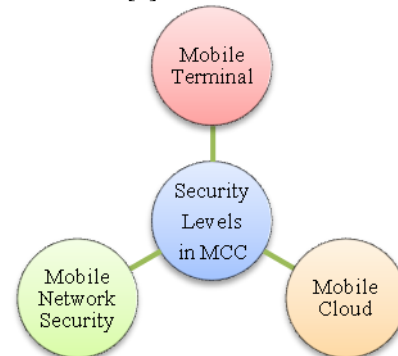

Figure 3. Security Levels in MCC.

The three level of security issues in MCC are Mobile Terminal, Mobile Network Security and Mobile Cloud.

A.   Level 1:Mobile Terminal

This level is basically an open operating system which permits wireless access of Internet at any time and at any location. Its security issues are discussed [9] in respect of software vulnerabilities and malware. Software vulnerabilities is related to the application software like email where end user to enter user id and password and this information is transferred to network by using FTP protocol. These all information related to end user is stored in text format and it permits unauthorized of Smartphone from personal computer if they are on same network. For this reasons, end user information is not being secured. Malware is a mechanism by which it can access the information of the end user without their knowledge. There are number of anti malware software to protect but they lacks in some resources and mobile terminals, it creates difficulties for malware detection and prevention. So, it requires to improvement.

B.   Level 2: Mobile Network Security

The network is access through smartphones using multiple access methods like phone service, SMS, and other internet services . Using WiFi and Bluetooth create security problems like threats and malicious attacks as these networks are not secured.

C.   Level 3: Mobile Cloud

There are two security issues [9] in mobile cloud: (a).platform reliability and (b) data and privacy protection. Platform reliability: as the cloud provide huge data storage which are valuable information resource and it can be threaten and may be attacked. The attackers can either be an inside user or unauthorized user. The primary objective of attacker is to destroy the cloud services. Data and privacy

protection: the data of the ownership and management of the end users are replicated in various locations , so, there would be requirement of privacy and protection.

IV.MCC CHALLENGES

The Mobile Cloud Computing is having number of critical challenges in the current scenario. These challenges are discussed in this section one by one in detail. The challenges are as follows [10].
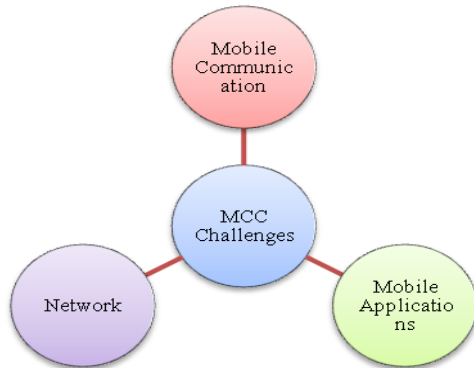

Figure 4. MCC Challenges

A.   Mobile Communications

✓ Low bandwidth Problem: It is major challenges in wireless mobile communication because bandwidth is shared and is limited among the mobile user.

✓ Lack of resources of mobile devices: It is costly when compare mobile device and traditional PC. To solve this problem, resources of mobile device are added into the cloud environment. So that it can be access anytime and anywhere.

B.   Network

✓ Wireless Network and Access Control Policies: Bandwidth is an important attribute for the fastest performance of any networks. There are three major factors such as data rate, latency, and connectivity may be raised the network problem in MCC.

✓ Seamless Connection Handover: It is also one of the major challenges when mobile user move from one place to another place and the application is executing in mobile device either terminated or returns error message.

C.   Mobile Applications

✓ Interoperability: The same network is sharing by different mobile users and it increase the chance which are running on different platform such Android, Window or other. In such situation ,

✓ Interoperability is major challenges among multiple mobile devices.

✓ Mobile Cloud Convergence: This challenge is concerned with mobile data, battery life and performance in multiple platforms.

V.MCC APPLICATIONS

Mobile cloud computing is getting more useful in different real life applications. People are using smart mobile devices not just to make and receive calls while the use of mobile phone has reached at next level. Mobile has become the easiest and economical platform for online marketing, online games, banking, and to access right time information. There are followings are applications using in the Mobile Cloud Computing [11].
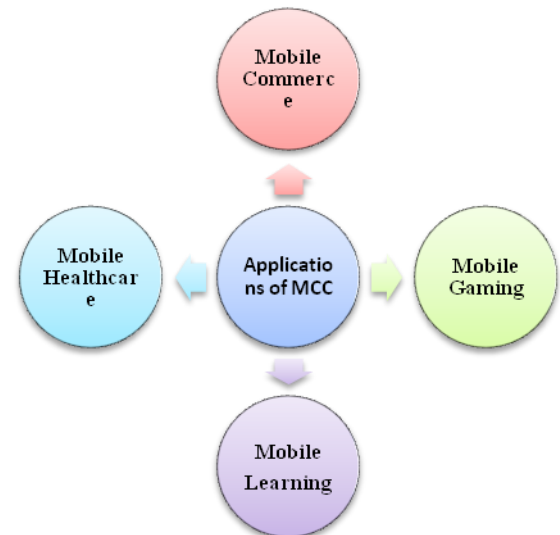

Figure 5. Applications of MCC

A.   Mobile commerce

Mobile commerce is also known as m-commerce and it is widely using in the business world.This applications are performed using mobile devices. It is based on mobility such as mobile banking, mobile transaction, mobile messaging, and mobile ticket booking etc. M-commerce applications having number of challenges [11] like the bandwidth problem, high complexity of mobile devices, configurations and security.

B.   Mobile Learning

Mobile learning is m-learning platform and it is designed for learning content or to study online while using mobile devices. It is also called cloud based electronic learning. Number of benefits using m-learning [11] such as faster processing speed, longer battery life and good service in w.r.t. of volume data size. Cloud based m-learning helps the students and teachers to access the reading material or resources from the remote system.

C. *Mobile Healthcare*

Mobile healthcare is basically cloud based which contained all information related to medical healthcare. This system removed conventional system in medical healthcare. By using m-healthcare ,patients are getting information related to medicine, health report, appointment with concerned doctors, patients health process report etc. There are five MCC applications[12] using in healthcare such as comprehensive health monitoring services, Intelligent emergency management system, Health-aware mobile devices, Pervasive access to healthcare information and pervasive lifestyle incentive management.

D. *Mobile gamming*

Mobile gaming is most popular gaming tools among young generation. It is also called m-gamming. Here ,the end user's mobile devices is having only GUI and all the software are at the remote server .i.e. in the cloud server. While playing games on their mobile user gets connect with cloud server and access the game through GUI of their mobile screens. The major advantage [13] is power saving in mobile devices which gave scope to play game for a longer period.

VI.CONCLUSION

This survey paper discusses the mobile cloud computing which is originated from cloud computing and mobile computing. It helps to the mobile devices to access the resources or services that are available in the remote cloud. In current era of information technology, mobile cloud computing is very active area for research. Due to it increases the battery life and maximizes the storage of mobile devices.In this paper we focus on different levels of security concerned in MCC, which is most important part for any communication technology. We have briefly discuss some major challenges of MCC has to suffer. Finally come to some real life applications where MCC is using at fast speed. Lastly, the impact of mobile cloud computing is growing day by day due to increasing interest in cloud computing to Internet of Things to mobile Internet of Things.

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