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Future Prospects of Public Utility Services through Mobile Clouds

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Abstract

Paper discusses the requirement of Mobile Clouds in the society. The architecture and deployment models have been discussed also. Mobile broadband connection and connection devices issues has elaborated with the discussion about 2G/3G/4G technologies and their future prospects. Mobile Cloud applications and Mobile Cloud apps marketing and its future have been mentioned clearly. The paper presents Mobile Clouds as a potential technology in the field of mobile services.

Keywords*: Mobile Clouds; Mobile Cloud Architecture; M-Commerce; M-Healthcare; M- Game; Mobile apps.*

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1. Introduction

Since the emergence of Web technology, there has been found the tremendous change in Information and Communication Technology (ICT) in terms of infrastructure development and service deployments of such ICT techniques. Due to developments of ICT tools and techniques, a lot of new techniques and services were emerged e.g. Web 2.0, Web 3.0, Cloud Computing, Mobile Clouds etc. Cloud Computing technology is recent in origin, for serving the users, over the Web using ICT infrastructure. Cloud Computing applications has been started through Mobile devices and its communication networks. The infrastructure and services of Mobile have been applied for Cloud services and known to us as Mobile Clouds. It has been found that services through Mobile Clouds are much cheaper than Computers and are very much helpful in business, telecommunication, information sharing, file sharing etc.

Techopedia [2] defines "Mobile Cloud Computing is a technique or model in which mobile applications are built, powered and hosted using Cloud Computing technology". Wikipedia [7] defines it as "the combination of Cloud Computing and mobile networks to bring benefits for mobile users, network operators, as well as cloud computing providers". National Institute of Standards and Technology (NIST), USA [8] defines "Cloud Computing is a model for enabling convenient, on-demand network access to a shared pool of configurable resources (e.g. networks, servers, storage, applications and services) that can rapidly be provisioned and released with minimal management effort or service provider interaction".

On the basis of above definitions, it has been inference that Mobile Cloud Computing is a new platform for creating a new infrastructure through combining the mobile devices and Cloud Computing. In Mobile Cloud infrastructure, data processing and data storage happen outside of mobile devices [1]. Mobile Cloud assists to build mobile applications designed specifically for mobile users in any mobile operating platform and any kind of memory capacity. Mobile Clouds is accessed through mobile browser from the remote web server [2]. Nowadays, Mobile Clouds gaining a stream as per the latest study done by Juniper Research. According to Juniper Research number of Mobile Clouds subscribers is expected to grow rapidly in coming five years as well as Cloud based mobile market will generate annual revenue of $9.5 billion in 2014 from $400 million in 2009, at an average annual increase of 88% [3].

2. Why Mobile Clouds?

Following are some reasons to which have some justification to use the Mobile Clouds:

1. Trends and demands: The users expect more and more convenience for using companies' websites or application from anywhere and at anytime which can be available through Mobile Clouds.
2. Improved and increased broadband coverage: 3G/4G technologies, Wi-Fi, femto-cells, fixed wireless etc. are providing better connectivity for mobile devices which become very easy to have Mobile Clouds for personal as well as official work.
3. Enabled technologies: Mobile Clouds have enabled number of technologies to provide better and fast services to their users. HTML5, CSS3, hypervisor for mobile devices, cloudlets and Web 4.0 are some enabled techniques for providing better services of Mobile Clouds [1].

3. Mobile Clouds: Architecture

The mobile devices are connected to the mobile networks through base stations that establish and control the air interface and functional interfaces between the networks and mobile devices. Mobile users' request and information are transmitted to the central processors that are connected to the servers providing mobile network services. Authentication, Authorization and Accounting type services will be provided to the users based on Home Agent and subscribers' data stored in databases. The subscribers' requests are then delivered to a cloud through the Internet. Cloud controllers present in the Cloud, process the requests to provide the mobile users with the corresponding Cloud services. These services are developed based on the concepts of utility computing, virtualization and service-oriented architecture. The major function of a Cloud Computing System is storing data on the Cloud and using technology on the client to access that data.

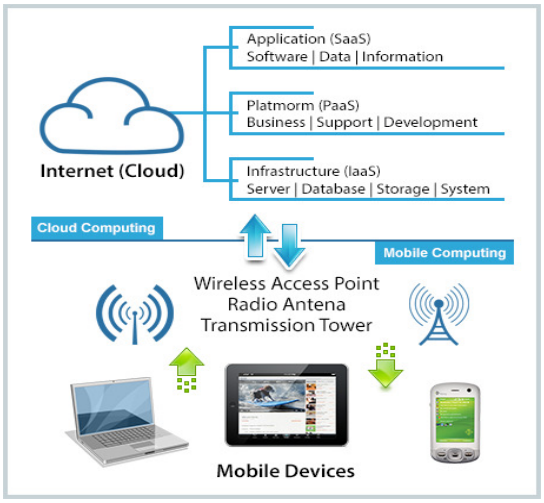

Fig. 1: Architecture of Mobile Cloud Computing [26]

Some scholars mentioned that Cloud Computing is not entirely a new concept [9] rather than it is a new paradigm in the sense that it presented a superior advantage over the existing under-utilized resources at the data centers. Several business models rapidly evolved to harness this

technology by providing software applications, programming platforms, data storage, computing infrastructure and hardware as services [8].

4. Mobile Clouds: Deployment Models

Following are the deployment models of Cloud Computing [10]:

4.1 Public Cloud: Cloud that offers its services to general public and owned by a third party organization are known as Public Cloud. Google, Amazon and Microsoft are examples of Public Cloud vendors who offer their services to the general public.

4.2 Private Cloud: This Cloud infrastructure is operated exclusively for an organization and may be managed by the organization or by third party (Mell & Grance, 2011). These Clouds can be accessed only by the employees and users of the organization. For example, an enterprise that wants to make customer data available to their different stores.

4.3 Hybrid Cloud: Hybrid Cloud infrastructure is a combination of two or more Clouds that are unique entities and bound together by standardized technology that enables data and application portability [24].

4.4 Community Cloud: Community Cloud infrastructure is shared by many organizations and supports a specific community that has shared concerns (Mell & Grance, 2011). The idea is that the costs are spread on several organizations that all are in need of the same services.

5. Mobile Clouds: Connection & Connecting Devices Issues

There is one important trend raising the extensive mobile Internet access is the availability of widespread mobile broadband services. On the study and analysis of Internet connectivity medium and its users, it has been found that there is a tremendous growth in the number of mobile broadband subscriptions in the world. The following table 1 is showing the percentage of broadband users that have different types of broadband connection and it can also be observed the higher growth of mobile broadband connection than others [4].

Figure 2 represents per 100 inhabitants data for different types of broadband connections in the world. The mobile-cellular telephone connections have been reached upto 93 inhabitant during 2001-2013 and till the end of 2014 it will reached upto 95.5 inhabitants. The Internet growth rate will be reached from 8 to 40 inhabitants at the end of 2014. Interestingly the fixed-telephone subscriptions will be reduced from 16.6 to 15.8 during 2001-2014. There is tremendous growth found for mobile broadband subscriptions from 4 to 32 within the 8 years from 2007 to end of 2014. The fixed-broadband connections growth is very slow than others i.e. from 0.6 to 9.8 in 14 years of journey.

At the end of 2014, as per ITU reports, there will be almost 3 billion Internet users, two-thirds of them coming from the developing world, and that the number of mobile-broadband subscriptions will reach 2.3 billion globally. Fifty-five percent of these subscriptions are expected to be in the developing world [5].

2G/3G/4G Subscribers in 2014

There is a report from GSMA Intelligence [6] which analyzes and presents an overview of 2G/3G/4G Cellular Network subscriptions market worldwide. This report, in addition, provides

global subscriber estimates and projections for 2G/3G/4G technologies in units for years 2012 through 2017.

Table 1: ITU Statistics Table of ICT Development

Subscription /Year	Mobile-cellular telephone subscription	Individual using the Internet	Fixed-telephone subscriptions	Active mobile broadband subscriptions	Fixed broadband subscriptions
2001	15.5	8.0	16.6		0.6
2002	18.4	10.7	17.2		1.0
2003	22.3	12.3	17.8		1.6
2004	27.3	14.1	18.7		2.4
2005	33.9	15.8	19.1		3.4
2006	41.7	17.6	19.2		4.3
2007	50.6	20.6	18.8	4.0	5.2
2008	59.7	23.1	18.5	6.3	6.1
2009	68.0	25.6	18.4	9.0	6.9
2010	76.6	29.4	17.8	11.5	7.6
2011	83.8	32.5	17.2	16.7	8.4
2012	88.1	35.5	16.7	21.7	9.0
2013	93.1	37.9	16.2	26.7	9.4
2014	95.5	40.4	15.8	32.0	9.8

As per Fig. 3, 3G/4G connections combined will account for about 4.25 billion of the 8.5 billion connections forecast by 2017 or 50% (40% 3G + 10% 4G). 2G connections are forecast to decline by over half a million over the next five years (down from 4.8 billion) as users migrate to next-generation 3G/4G networks and devices. In another forecast by GSMA Intelligence, 3G and 4G technologies will account for half of all global mobile connections in next five years [6].

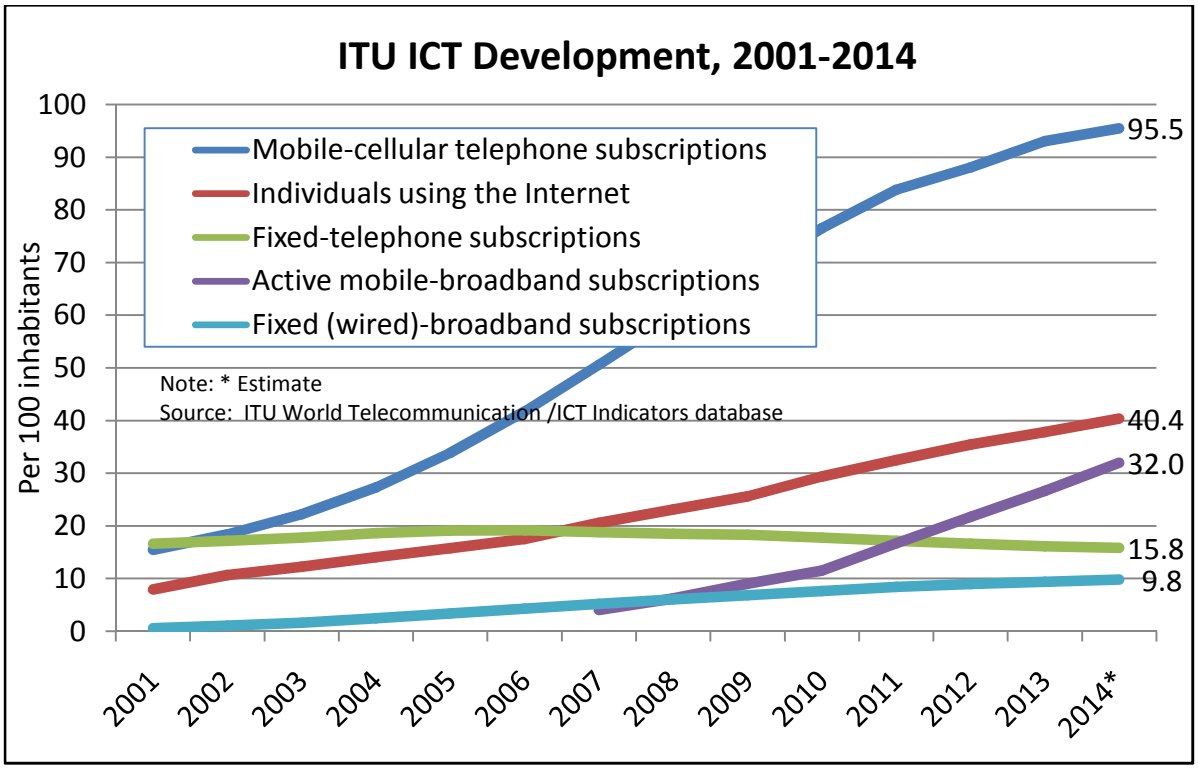

Fig. 2: Global ICT Development (2001-14) by ITU

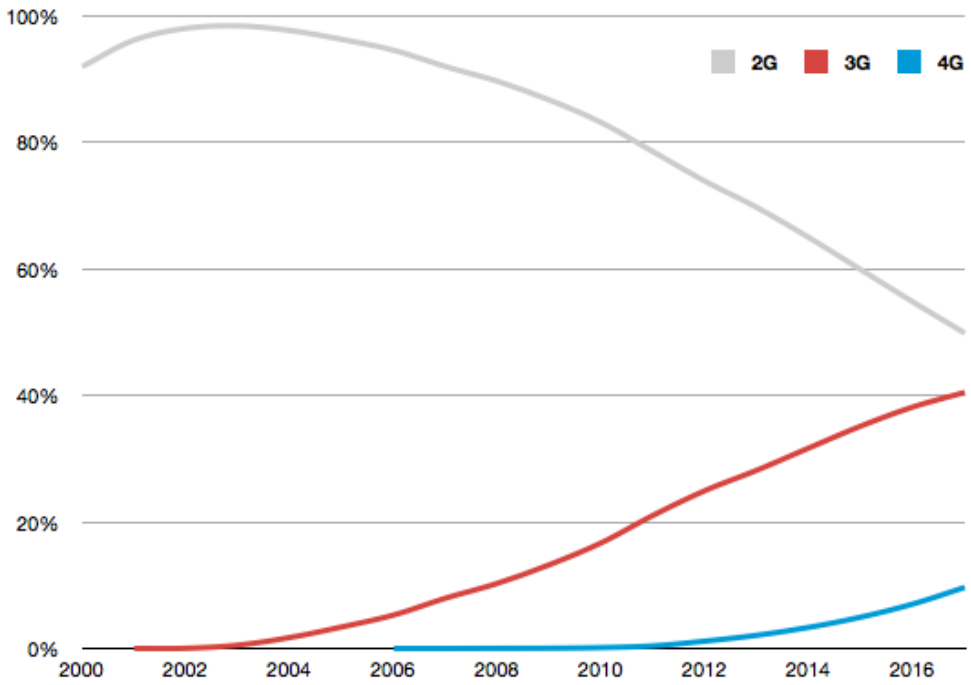

Fig. 3: Global connections by technology generation, 2000-2017
(Source: GSMA Intelligence)

6. Mobile Clouds: Mobile Devices & Platform Issues

Feature Phones and the Cloud: A feature phone is more capable than a dumb phone, but often it has a screen that is limited to text or very low-end graphics. A survey of 4001 Canadians by Media Technology Monitor in 2012 suggested about 83% of the Anglophone population owned a cell phone, up from 80% in 2011 and 74% 2010. About two thirds of the mobile phone owners polled said they had a Smartphone and the other third phone owners had feature phones or non-smart phones [11].

Smart Phone with the Cloud: In the beginning, there were cell phones and personal digital assistants (PDAs). Cell phones were used for making calls, and not much else, while PDAs were used as personal, portable organizers. Eventually, PDAs gained wireless connectivity and were able to send and receive e-mail. Cell phones, meanwhile, gained messaging capabilities, too. PDAs then added cellular phone features, while cell phones added more PDA like features. The result was the smartphone [12]. In the third quarter of 2012, one billion smart phones were in use worldwide. As of 2013, 65% US mobile consumers own smart phones. The European mobile device market as of 2013 is 860 million. In China, smart phones represented more than half of all handset shipments in the second quarter of 2012 [13].

Mobile Platforms and Operating Systems: There are several different manufacturers of mobile phones and also a diverse field of what operating systems the mobile phones are using. Some of the operating system are: Android by Google in 2003, Bada by Samsung in 2009, Blackberry by Blackberry Inc. in 1999, Firefox by Mozilla in 2012, iOS by Apple in 2007, Palm OS by Handspring in 2002, Saifish by Jolla, Symbian by Psion in 2010, Windows by Windows CE in 2000. Mobile phones that are sold during 2013 are running Android 78.4%, iOS 15.6%, and Microsoft 3.2% (Gartner, February, 2014) [25]. The applications developed for the different operating systems are usually not compatible with other operating systems and the application development language usually differs between them. Android applications are generally built in Java, iOS are built in Objective C, and Symbian in C++ or Java. Application developers need to learn a wide variety of different programming languages, architecture and memory management to be able to develop for all platforms [13].

7. Mobile Clouds: Applications

As we know that, mobile applications have big share in global mobile market and these applications have taken the advantages of Mobile Cloud Computing. There are some important mobile applications through which Mobile Cloud services can be rendered are as follows:

Mobile Commerce: It is also known as M-Commerce, and applied on mobile transactions and payments, mobile messaging as well as mobile ticketing. The M-Commerce applications and services are including finance, advertising and shopping applications & services. There are a lot of barriers in M-Commerce applications & services like low network bandwidth, high complexity of mobile device problems, and security. Therefore, M-Commerce applications are integrated into Cloud Computing Environment to address these issues [14]. This paradigm combines the advantages of both 3G network and Cloud Computing to increase data processing speed and security level based on Public Key Infrastructure (PKI). The PKI mechanism uses an encryption based access control and an over-encryption to ensure privacy of user's access to the outsourced data [15].

Mobile Learning: Also known as M-Learning, is designed based on electronic learning (E-Learning) and mobility. However, traditional M-Learning applications have limitations in terms of high cost of devices and network, low network transmission rate, and limited educational resources. Cloud based M-Learning applications are introduced to solve these limitations. For example, utilizing a Cloud with the large storage capacity and powerful processing ability, the applications provide learners with much richer services in terms of data (information) size, faster processing speed, and longer battery life [16]. Combination of M-Learning and Cloud Computing enhance the communication quality between students and teachers and Cloud based M-Learning system helps learners access learning resources remotely. Through mobile phones, learners can understand and compare different algorithms used in mobile applications (e.g. de-blurring, de-noising, face detection, and image enhancement) [17].

Mobile Healthcare: Mobile Healthcare (M-Healthcare) provides mobile users with convenient helps to access resources (e.g. patient health records) easily and quickly. Besides, M-Healthcare offers hospitals and healthcare organizations a variety of on-demand services on Clouds rather than owning stand-alone applications on local servers. There are a few schemes of Mobile Cloud Computing applications in healthcare. There are five important mobile healthcare applications [18], in the pervasive environment, are as follows:

a. Comprehensive health monitoring services enable patients to be monitored at anytime and anywhere through broadband wireless communications.
b. Intelligent emergency management system can manage and co-ordinate the fleet of emergency vehicles effectively and in time when receiving calls from accidents or incidents.
c. Health-aware mobile devices detect pulse rate, blood pressure, and level of alcohol to alert healthcare emergency system.
d. Pervasive access to healthcare information allows patients or healthcare providers to access the current and past medical information.
e. Pervasive lifestyle incentive management can be used to pay healthcare expenses and manage other related charges automatically.

Similarly, proposes @Health Cloud, a prototype implementation of mobile healthcare information management system based on Cloud Computing and a mobile client running Android Operating System. This prototype presents three services utilizing the Amazon's S3 Cloud Storage Service to manage patient health records and medical images [19].

Mobile Gaming: In short known as M-game, can completely of load game engine requiring large computing resource to the server in the Cloud, and gamers only interact with the screen interface on their devices. Cloud based M-game used rendering adaptation technique to dynamically adjust the game rendering parameters according to communication constraints and gamers' demands. The rendering adaptation technique mainly bases on the idea to reduce the number of objects in the display list since not all objects in the display list created by game engine are necessary for playing the game and scale the complexity of rendering operations [20].

Other Cloud Applications: A Cloud becomes a useful tool to help mobile users share photos and video clips efficiently and tag their friends in popular social networks as Twitter and Facebook. "MeLog" is a Mobile Cloud Computing application that enables mobile users to share real-time

experience (e.g. travel, shopping, and events) over Clouds through an automatic blogging. The mobile users (e.g. travelers) are supported by several Cloud services such as guiding their trip, showing maps, recording itinerary, and storing images & videos [21]. It also introduces a mobile location service allowing users to capture a short video clip about the surrounding buildings. The matching algorithm run on a Cloud can use a large amount of information to search for a location of these buildings. One Hour Translation provides an online translation service running on the Cloud of Amazon Web Services which helps mobile users, especially foreign visitors; receive the information translated in their language through their mobile devices. The Cloud becomes the most effective tool when mobile users require searching services (e.g. searching information, location, images, voices, or video clips) [22]. In addition, there are a mobile-cloud collaborative application to detect traffic lights for the blind, a Cloud Computing Framework to monitor different corners in a house through a mobile device, and some efforts which integrate current services (e.g. Bit Torrent and Mobile Social Network) into the Clouds as in. Thereby, it can be recognized that Mobile Cloud Computing is probably a prevailing technology trend with numerous applications in the near future [23].

8. Mobile Clouds: App for Mobile & its Marketing

Google's Gmail and Google Voice for iPhone are just two of the well known Mobile Cloud apps. Mobile Cloud Computing is referred to as the infrastructure where both the data storage and the data processing happen outside of the mobile device. From a consumer's point-of-view, a Cloud based mobile application is similar to an app purchased or downloaded from a mobile application store like iTunes, where the processing power is driven not from the hand held device, but from the Cloud [3].

Gartner researchers estimated that $7 billion will be generated by the app store businesses and would reach $29.5 billion by the end of 2013. This would grow even more by 2014 when the Mobile Cloud based application market is expected to near $9.5 billion. From these estimations, it appears that in the near future, there will be more growth for both traditional, device-based apps and Mobile Cloud based apps [3].

9. Conclusions

The Information and Communication Technology (ICT) tools and techniques are well known carrier for Internet and the Web services. Presently, majority of the services available on virtual world i.e. Web. Telecommunication and online storage are one of the major parts in Cloud based services where user stores his data through mobile devices. Mobile Clouds has shown better future than Clouds through personal computers. Trend analyst and researchers have predicted the future of Cloud, that it will be driven by Mobile devices i.e. Mobile Clouds. Mobile broadband subscriptions rate is increasing very fast in the form of 3G/4G services. Mobile apps market for Cloud services are also increasing. There are various services available for public through Mobile Clouds like M-Commerce, M-Learning, M-Healthcare, M-game, Translation services, Tourist Guide services, Blogging etc. There are various stakeholders who are providing such services free of cost like Google, Amazon, Twitter, Facebook etc. The future of such services will be Mobile Cloud based which can be availed anywhere and anytime. Libraries and Information Centers have also to think to utilize the techniques and infrastructure of Mobile Clouds for providing the better and fast services to their users on their mobiles.

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