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Mobile Cloud Computing: A Review of its Applications and Challenges

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Abstract: In the last few years there is an explosive growth in the field of Mobile computing and cloud computing. So, the idea came of mobile cloud computing, which is the combination of both. Mobile Cloud Computing includes various mobile devices that are involved in cloud services. Tremendous growth in use of Smart phones is also the reason behind idea of mobile cloud computing. This paper presents a review of cloud computing, its applications and various challenges that it faces.

Keyword: Mobile Cloud Computing, Cloud Computing, Mobile Computing.

I. Introduction

Mobile Cloud Computing combines the features of three systems which are mobile computing, cloud computing, and wireless networks. As you know how much cloud computing and mobile computing individually has affected us. Both provides us with a great so, the idea of Mobile cloud computing is to use cloud services in mobile devices. Computing is done at the cloud. User need not to own any physical storage, or any kind of software resource. He can perform computations on cloud and use the storage space on cloud. User has to pay per use i.e. he will pay only for the services he is using. With the help Mobile Cloud Computing, a mobile user gets a rich application delivered over the Internet and powered by cloud-backed infrastructure [1]. In this mobile applications are built as well as deployed on cloud. Mobile cloud is accessed by mobile device with the help of internet. There is no need of installing client's application on his device.

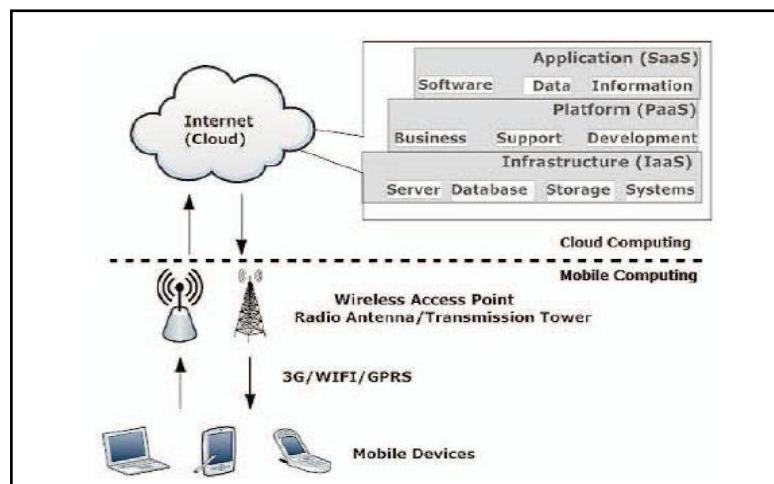


Figure1. Mobile Cloud Computing Architecture [2]

II. Mobile Cloud Computing Services Model

A figure is shown below showing service model of Mobile Cloud Computing.

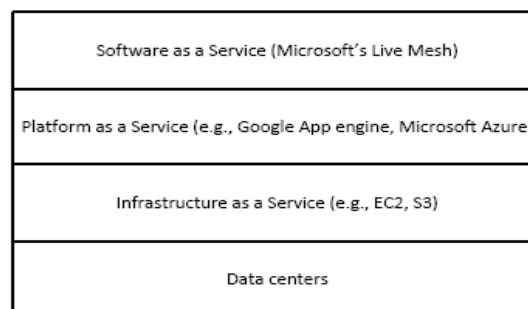


Figure2. Service-oriented cloud computing architecture [3]

A. Data centers layer

As name suggests, data center layer deals with the hardware resources and infrastructure of clouds. Data center layer consist of a large number of servers connected with each other's via high speed networks.

B. Infrastructure as a Service (IaaS)

It basically provides users with virtual servers. On the network there are a number of users having access to single hardware on cloud [3, 4]. It provides each user with facility of individual servers, disk drives, computing resources, private networks, messaging systems etc. These services are charged. User has to pay on the basis of what they use. i.e. he has to pay only for services that he is using. For example: Amazon Web Services.

C. Platform as a Service (PaaS)

It provides users with a platform to create their applications over the internet. It gives user the facility physical server. Users can control their application, but they does not have control over the cloud infrastructure. For example, Google Apps.

D. Software as a Service (SaaS)

It provides user with a facility to run applications. User need not to install any kind of software on their device. They can run it on cloud infrastructure. In this also user has to pay only for what he use [3, 4]. For example, web-based emails, Microsoft Office365, Microsoft's Live etc.

III. Characteristics Of Mobile Cloud Computing

A. Ubiquitous

Services provided by Mobile cloud computing are accessible anytime, anywhere. User can access services at the time when he needs.

B. Security and Privacy

A major add on for mobile users using mobile cloud computing applications is to protect users' data. It gives user access to decide what information could be exposed and what information should be kept as secrets [5].

C. Virtualization

It provides with clouds for mobile devices which provide virtual servers and storage devices over the network to mobile devices. These services can be shared among different users. User can easily migrate its applications one server to another [6].

D. Pay per use

User has to pay only for what he uses. Means user has to pay only for services he is using.

E. Caching

It also has caching capability. With which it can store whole information of an application in cache. State Management is done through caches. Mobile clouds maintain state of mobile cloud computing applications of mobile devices. Partially delivered data, lost connections, and half operated functions can be resumed, as a result, this will Strong reliability and fail-over protection. As we know damage and loss of mobile devices are common due to their small and portable nature. Mobicloud provides a suite of solutions to protect the mobile users' data and provide data recovery it due to failure, lost or stolen, and upgrade [5].

F. Broad network access

Services are available all the time over the network. Services are accessible through any type of mobile device like Smart phones, tablets etc.

G. Rich software development platform

Mobile Cloud computing provides users with rich software develop platform. Users can create and deploy their applications on the mobile cloud from their mobile devices. Because of The IaaS and PaaS features it becomes possible. Moreover, it is easier to integrate various applications in the mobicloud system with little compatibility issue [5].

H. Scalability

Scalability in any application is very important thing to keep in mind. So, as to make an application reliable and to keep its performance good all the time. Mobile cloud computing provides scalability, because if users on mobile cloud increases it does not affect performance of mobile applications of any user.

IV. Applications

A. Mobile Games

Games need good quality of graphics and large amount of memory in your device. But mobile devices do not have that much memory and good graphics processing. So, Mobile cloud computing, provides user with a cloud gaming server where all kind of graphics processing and other things that are requires to run a game are provided to user. While playing game user simply has to give commands through his mobile device, whole processing is done at the cloud infrastructure. The objective is to maximize the user experience given the communications and computing costs [2, 3].

B. Cloud Augmented Reality

Augmented reality means, there is a virtual environment with which user can interact. This technique is sometimes used in games. But due to less battery power, less storage capacity and other issues of mobile

devices, it becomes difficult to user to use this [3, 7]. So, mobile cloud computing can also be used with augmented reality, so that all kind of processing is done at the cloud and user can have ease of playing game on their mobile devices.

C. Cloud Based Mobile Learning

Mobile learning is becoming popular because almost every person has mobile devices and they used their mobile devices for learning purpose. Mobile learning is designed based on electronic learning (e-learning) and mobility. [2,3] However, traditional m-learning applications have limitations in terms of high cost of devices and network, low network transmission rate, and limited educational resources [3]. To overcome these limitations mobile cloud computing plays a great role.

D. Mobile Healthcare

Mobile cloud computing also has great impact in healthcare applications. With the help of mobile cloud computing many errors can be removed that were during traditional health care applications. Mobile health care provides various benefits like patient tracking and health monitoring any time anywhere. Also patient as well as health organizations can monitor patient's recovery by analyzing their past and current health information that is store in the cloud. Emergency management system for emergency vehicles to reach or manage vehicles effectively and in time, in case of receiving calls from incidents and accidents [2, 8].

E. Mobile Commerce

Mobile cloud computing can also be used in field of e-commerce and there it is called Mobile commerce or M-commerce. It allows business models for commerce using mobile devices. For example: Mobile Shopping, Mobile financial, Mobile advertising etc. With the help of mobile cloud computing data processing speed will become very high and also transactions will become more secure.

V. Challenges

A. Quality of service(QoS):

QoS is the idea of managing to manage network resources so as to increase transmission rates, decrease error rates etc. High amount of QoS specifies how good our network is. QoS is achieved by managing bandwidth, delay etc. But as you know in case of wireless network is always more than that of in wired network. So, there are delays in case of mobile cloud computing which are not accepted by users [9].

B. Bandwidth Costs

One hand mobile cloud computing saves the hardware and software costs. On the other hand bandwidth cost is high. Because of traffic over the network or because of network attacks delays are produced. So, to deal with this problem high bandwidth is required. Bandwidth requirement may cost low for small applications but for large applications like data intensive application cost can be high [2].

C. Limitations of the hand-held devices:

As we know mobile computing has its own challenges like less storage, less battery backup, small screens, less processing speed etc. So, in mobile cloud computing also we have same problems. As compared to PCs and laptops, the modern mobile devices like the iPhone 5 or the Android or Window mobile phones, reduce the processing capability by 3 times, memory by 5-6 times and bandwidth by around 10 times[2].

D. Utilize Multiple Clouds in a Unified Fashion

It is not always possible that user all tasks can be done on a single cloud. Some time users may need more than one cloud at the same time and for the same application. In this case mobile Cloud computing should provide a unified way to do so [9].

VI. Conclusion

Mobile Cloud computing is still a new concept. Still it is getting a very good response from users. It combines the features of both cloud computing and mobile computing. It has various applications like Mobile Games, Cloud Augmented Reality, Cloud Based Mobile Learning and Mobile Healthcare. It was concluded that in the coming year's mobile cloud computing will become more popular.

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