

STUDY ON MOBILE CLOUD COMPUTING, IT'S ARCHITECTURE, CHALLENGES AND VARIOUS TRENDS

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Abstract: Mobile Cloud Computing (MCC) is a combination of three main parts; they are mobile device, cloud computing and mobile internet. With the help of MCC, a mobile user gets a rich application delivered over the Internet. Increase use of mobile user's day by day we can witness evolution in the mobile technology and its services. Mobile devices face many resource challenges (battery life, storage, bandwidth etc.) MCC provides mobile users with data storage and processing services in clouds, obviating the need to have a powerful device configuration (e.g. CPU speed, memory capacity etc.) Mobile Cloud Computing (MCC) integrates the concept of cloud computing into the mobile environment. So we need to keep a track of the news trends in MCC. This paper presents a review on the background and principle of MCC, Challenges; Applications of MCC are explored and analyzed.

Keywords-Mobile Cloud, Mobile Cloud Computing, Mobile Cloud Computing Architecture, Mobile Cloud Computing Applications, Security in Mobile Cloud Computing, Mobile Service Clouds, Mobile Cloud Computing Trends.

I. INTRODUCTION:

Mobile devices are increasingly becoming an essential part of human life as the most effective and convenient communication tools not bounded by time and place. The rapid progress of mobile computing (MC) becomes a powerful trend in the development of wireless communications technology as well as commerce. The increased capabilities of mobile devices, Access of internet using Mobile devices than PCs. Growth in the use of Smart phones, their app sand emerging cloud computing concept, Mobile Cloud Computing has been introduced.

MCC is the combination of mobile computing and cloud computing, this provides full access to all technology resources through the cloud "Anytime, Anywhere, Anyhow". Mobile Cloud Computing, which is simply the use of Cloud Computing technology on a mobile device.

Mobile Cloud Computing is mobile cloud computing technology and provides our customers full access to all technology resources through the Cloud – anytime, anywhere, anyhow.

Anytime: In 2013, there were more than four billion mobile phones in use across the globe. By the end of 2017, that number is expected to grow in excess of six billion. And people are using these phones for so much more than just making calls. Nowadays, mobile phones and other Internet-ready devices, like tablets, are quickly replacing personal computers in the workplace. This is especially true for businessmen and women who constantly travel

Anywhere: Mobile Cloud Computing enables people perform their daily tasks from anywhere on the globe, as long as they have Internet access.

Anyhow: Whether using a BlackBerry® or Android®, iPhone® or iPad®, We can access all their information from any device or operating system.

Mobile application is vastly used in this time for various tasks such as shopping, marketing, payment etc. Mobile application faces some challenges like security, low bandwidth, limited storage and processing power hence is not widely used for business perspective. Cloud computing technology provides much large storage capacity, fast computation, security, and the most important on-demand access.

Why Mobile Cloud Computing (MCC) is Important

Mobile devices face many resource challenges such as battery problem, storage and bandwidth. Mobile Cloud Computing offers advantages to users by allowing them to utilize infrastructure, users with data storage and processing services in the cloud, eliminating the need to have a powerful device configuration like CPU speed, memory capacity, as all resource-intensive computing can be performed within the cloud.[2]

The Mobile Cloud Computing Forum defines MCC as “Mobile Cloud computing at its simplest refers to an infrastructure where both the data storage and the 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 mobile computing to not just smart phone users but a much broader range of mobile subscribers” [3]. In simple words, mobile cloud computing provides the cloud services on the platform of mobile devices. It is a very interesting topic to explore with major players in this field like Google, Microsoft, and Amazon and so on.

Practically if you see the main advantage of MCC that the end consumer can have access to more features on the phone and also it helps to save a lot of money in business,

This is why it becomes so important to analyze the new trends in MCC because in a way they are affecting our real time

II. LITERATURE REVIEW

Mobile Computing refers to a broad set of computing operations that allow a user to access the information from portable devices such as laptops and computers,

PDA's, cell phones, handheld devices/Computers, music players, portable game devices, and so on.

Significant work has been done security, privacy, challenges mobile cloud computing, and mobile cloud computing in various areas like Business, smart city, Learning Application, E-commerce, and 5G.

Researchers proposed Cloud computing is clearly one of the most enticing technology areas of the current times due, at least in part to its cost-efficiency and flexibility. Security and privacy are one of the most challenging issues in MCC.

III. BACKGROUND

Before studying MCC Architecture we must understand cloud computing and mobile computing and after which we can understand trends in a much better way.

CLOUD COMPUTING: Cloud computing is a general term for the delivery of hosted services over the Internet. Mobile Cloud Computing refers to an infrastructure where both the data storage and the data processing occur outside of the mobile device. Mobile cloud applications move the computing power and data storage away from mobile phones into the cloud, bringing applications and mobile computing not only to smart phone users but also to a much broader range of mobile subscribers [4].

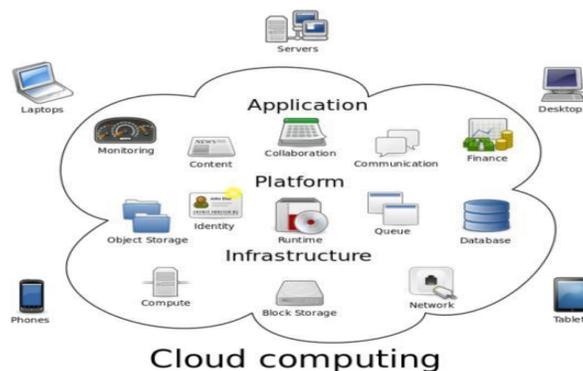


Figure 1 Cloud Computing

MOBILE CLOUD COMPUTING: Mobile devices are increasingly becoming an essential part of human life as the most effective communication tools not bounded by time and place. Mobile users accumulate rich experience of various services from mobile applications, which run on the devices and/or on remote servers via wireless networks. The rapid progress of mobile computing (MC) becomes a powerful trend in the development of IT technology as well as commerce and industry fields. However, the mobile devices are facing many challenges in their resources (e.g., battery life, storage, and bandwidth) and communications (e.g., mobility and security). The limited resources significantly impede the improvement of service qualities [5].

There are so many cloud storage service providers around e.g. One Drive (Microsoft Corporation), Dropbox (Dropbox Inc.), Google Drive (Google Inc.), and Box, Amazon Cloud Drive and Apple iCloud. Cloud computing applications are the cloud-based services e.g. Mobile Email, Google Maps, Google

IV. MCC MODELS

A) Service Models of MCC

1. **Infrastructure as a Service (IaaS):** It involves outsourcing the equipment used to support operations, including storage, hardware, servers and networking components [8]. Virtualization is extensively used in IaaS clouding order to integrate or decompose physical resources. Clients are able to deploy and run arbitrary software, which can include operating systems and applications. The client does not manage or control the underlying cloud infrastructure but has control over the operating systems; storage, deployed applications and possibly limited control of selected networking components (e.g. host firewalls) [8]. Examples of IaaS include Amazon Elastic Compute Cloud (EC2), Rack space, and IBM Computing on Demand

2. **Platform as a Service (PaaS):** PaaS is a development h allows client to develop cloud services and applications directly on the PaaS cloud. PaaS offers development platform that hosts both completed and in-progress cloud applications. An example of PaaS is Google AppEngine [8].

3. **Software as a Service (SaaS):** Client releases their application on a hosting environment which can be accessed through network from various clients by application users. The client does not manage or control the underlying cloud infrastructure with the possible exception of limited user-specific application configuration settings. Google Apps and Microsoft Office 365 are the examples for SaaS [8][9]



Figure 2 Service Cloud Model

B) Cloud Deployment Models:

There are main three different deployment models and each model has its own benefits and cons as in [10]. Apart from these there is also community cloud which is rarely used. Figure Fig.3 depicts all these deployment models

1. Private cloud: This cloud is setup specifically for an organization within its own data center. The organizations manage all the cloud resources which are owned by them. The private cloud offers more security as compared to public or Hybrid cloud.
2. Public cloud: This cloud is available to all the external users through internet who can register with cloud and can use cloud resources on a pay-per-use model. This cloud is not secure like private cloud because it can accessible for all internet users.
3. Hybrid cloud: This is a type of private cloud which uses the resources of one or more public clouds. It is a mix of both private and public cloud.
4. Community Cloud: Several organizations jointly construct and share the same cloud infrastructure as well as policies, requirements, values and concerns. The cloud community forms into a degree of economic scalability and democratic equilibrium. The cloud infrastructure could be hosted by a third-party vendor or within one of the organization in the community.



Figure 3 Cloud Delivery Models

V. MCC ARCHITECTURES AND PRINCIPALS

Mobile cloud computing is a combination of mobile computing, cloud computing and mobile Internet. It can be stated as availability of cloud computing facilities in the mobile environment. It integrates the advantages of all the three technologies and can thus be called as cloud computing for mobiles. Mobile cloud computing is a new model where the data processing and storage is moved from mobile devices to powerful and centralized computing platforms located in clouds. These platforms can then be accessed through wireless connections via web browsers on the mobile devices. This is similar to cloud computing, but the client side has changed to make it viable for mobile phones, but the main concept behind it is still cloud computing. As shown is the Fig. 4, mobile cloud computing can be simply divided into cloud computing and mobile computing.

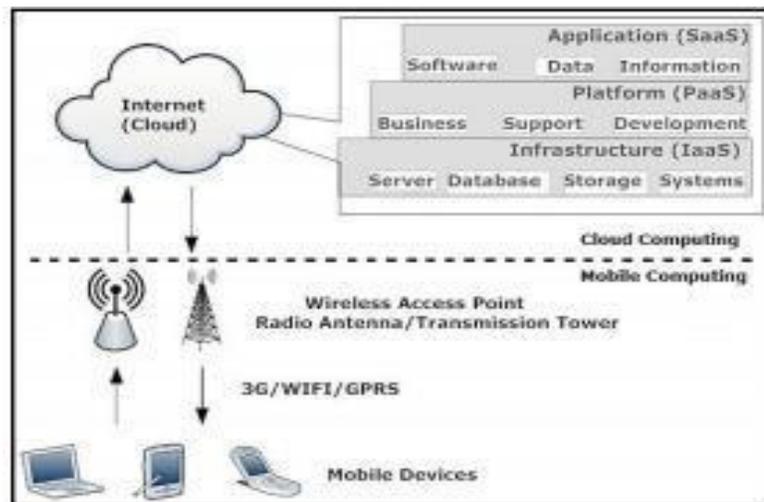


Figure 4 Architecture of MCC

VI. OPEN ISSUES AND FUTURE RESEARCH DIRECTIONS

Although some projects of mobile cloud computing has already been deployed around the world, there is still a long way for business implementation, and some research aspects should be considered in further work.

A. Data delivery: Due to the feature of resource constraints, mobile devices have potential challenges in cloud accessing, consistent accessing, data transmission, and so on. Such challenges can be solved using: special application (service) and middle-ware. Basically provide a platform for all mobile cloud computing system

B. Task division: Researchers divide tasks (applications) from mobile devices into multiple sub-tasks and deliver some of them to run in cloud, which is a good solution to the resource limited mobile devices. However, we do not have an optimal strategy or algorithm on how to divide these tasks, which one should be processed by cloud and which one by devices.

C. Better service: The original purpose of mobile cloud computing is providing PC-liked services to mobile terminals. However, as the existing different features between mobile devices and PCs, we cannot directly transplant the services from PCs" platform to mobile devices. Therefore, further research should try to identify the method on how to provide suitable and friendly interactive services for mobile devices.

D. Standard interface: The current interface between mobile devices and cloud is based on web interfaces. These interfaces are not designed for the mobile devices and thus carry huge overheads. Also, compatibility among mobile devices may be an issue. To overcome this flaw, a standard protocol and interface needs to be designed.

E. Quality of service: The original goal of mobile cloud computing is to provide PC-like services on the mobile devices. Since, there are a diverse features existing between PCs and mobile devices, we cannot directly shift the services from the computer's platform to mobile devices. In addition, mobile users may face delay in communication with the cloud because of congestion due to bandwidth limitation, network disconnection and signal attenuation.

F. Trust, security, and privacy issues: Trust is an essential factor for the success of the burgeoning MCC paradigm. Constructing a trustable, secure environment is an open issue which is exacerbated when the Internet is utilized as the bridge between front-end and back-end devices (over wireless and wired networks). Provisioning security and providing data integrity and reliability besides delivering essential services (e.g. always on connectivity and cloud services) over the heterogeneous distributed systems, wireless networks, and the Internet require novel lightweight methods.

VII. BENEFITS OF MOBILE CLOUD COMPUTING

Mobile cloud applications move the computing power and data storage away from mobile phones and into the cloud, bringing apps and mobile computing to not just smart phone users but a much broader range of mobile subscribers. In this section, we enlist the possible benefits of Mobile Cloud Computing [12].

☒ Mobile Cloud Computing will help to overcome limitations of mobile devices in particular of the processing power and data storage.

☒ It also might help to extend the battery life by moving the execution of computation-intensive application „to the cloud“.

☒ Mobile Cloud Computing is also seen as a potential solution for the fragmented market of mobile operating systems with currently eight major operating systems.

☒ Mobile Cloud Computing can increase security level for mobile devices achieved by a centralized monitoring and maintenance of software, It can also become a one-stop shopping option for users of mobile devices since Mobile Cloud Operators can simultaneously act as virtual network operators, provide e-payment services, and provide software, data storage, etc. as a service.

☒ A number of new technical functionalities might be provided by mobile clouds. In particular, provisioning of context- and location-awareness enables personalization of services is an attractive functionality.

☒ Mobile Cloud Computing might open the cloud computing business that is currently almost exclusively addressing businesses to consumers since they will significantly benefit from the above described options.

VIII. TRENDS IN MCC

We have now got an overview of what is MCC and its architecture so now let us discuss the latest trends which are upcoming and also been recently implemented. [13]

1) Security The most important trend which everyone should be interested in is security of MCC. The latest example of security would be encryption of messages on WHATS APP. Everyone in the mobile industry is trying its best to provide the best security to data of the users on mobile platform.

2) Increase of Business on Mobile As we all know e-commerce is shifting on mobile and has lot of improvements day by day. We are seeing new trends in business which is through mobile apps which is evolving day by day and would go to a next level in the upcoming years. Many mobile apps such as Amazon, Myntra, BookMyshow and so on are example of it .

3) Enterprise Mobile Management Enterprise Mobile Management (EMM) will consist of management of mobile devices. EMM would be in lot of demand soon.

4) Mobile Cloud Content Management With more and more data over the cloud and important task would be manage its content so that what content should be shown to app users would be of great concern and necessary to keep a tab of.

IX. APPLICATIONS OF MCC

So far, there are a large number of mobile applications which have taken the advantage of MCC. These applications have made a huge impact on the market and their value has increased a lot. Here are few of them supported by MCC [11].

A) Mobile Commerce

MCC made life easy for commerce by providing mobile commerce (m-commerce) using mobile hand held devices. Any time any place customers can buy a product what they want through the Internet connection. The applications like finance, shopping, ticket booking etc. are facing some serious challenges because of low bandwidth, complex mobile architecture and

serious security risks. However, the MCC provides the solution for these challenges by integrating m-commerce applications into the cloud environment. 6.

B] Mobile Gaming

Mobile gaming (m-gaming) is one the most popular service for the cloud service providers in terms of revenue generation. Usually, all the mobile games require high computing resources like, graphics rendering. Its need high graphics However, in the cloud the m-game can off-load game engine which requires graphic rendering to the cloud server. This way, mobile users can only interact with the screen displays on their devices while all other computation is being performed at the cloud servers.

C] Mobile Cloud Computing in Business

Business can be more powerful and efficient by incorporating Mobile Computing and Cloud Computing in it. Mobile services provides effectiveness for the mobile related issues, E-commerce development based on cloud computing also solves the problem of scalability and provides on demand services to the consumer [14]. Many activities such as shopping, mobile balance recharging, ticket booking, billing, recruitment process, advertisement, data sharing can be easily done using MCC.

Benefits Mobile Cloud Computing In Business

Consumers have access to more features on their mobile phones

Mobile cloud computing allow customers to perform online transaction from anywhere at any time with fast access and security. [8]

Large market can be covered by business with use of mobile cloud

As Enterprise incorporates mobile cloud computing, it enhances the range of reachability. It useful for small enterprise to large enterprises by on demand and anywhere access that able reach at global market with big amount of customers while investing less revenue.[8]]

D] Healthcare in Mobile Cloud Computing

Healthcare services are created by the combination of all medical care services including doctors, hospitals, laboratories, pharmacies, and other support items. These services have been advancing step by step starting from traditional healthcare till cloud healthcare.

The integration of cloud and mobile computing lead to an extensive flexibility of accessibility of services. One of the major issues is integrating the healthcare services in addition to that the integration of mobile and cloud computing as presented in figure

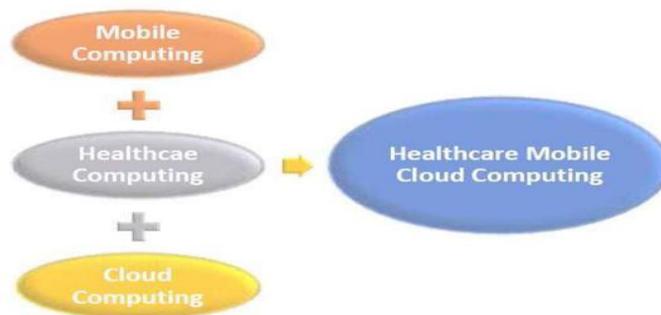


Figure 5 Integration Of Healthcare, Mobile and Cloud Computing

The structure of healthcare, mobile, and cloud computing approach began by combining all wireless devices with the Internet via wireless service provider in which is connected to the cloud service provider that offers all requested applications

Cloud computing environment including infrastructure, platform, software and healthcare services; with their support of servers, databases, storage and systems. Mobile computing environment including mobiles, satellite and Internet; with their hardware equipment and devices.

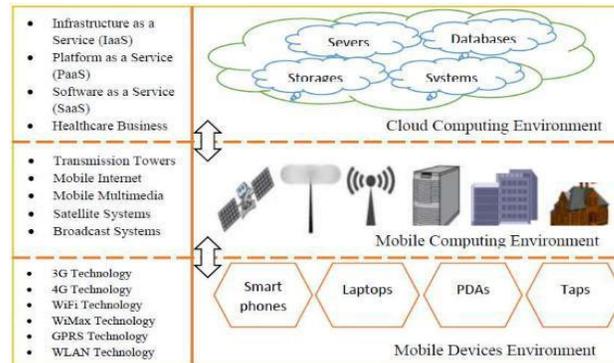


Figure 6 Mobile Cloud Healthcare Structure

E] Mobile cloud computing in Learning

The traditional teaching pattern of university courses is very simple in that not all student are taking interested in that , but not necessarily effective. In order to improve students’ interest and initiative in learning, the authors put forward an innovative idea to achieve mobile learning by introducing mobile cloud computing technology to university teaching methods. More specifically, as demonstrated in this article, the authors have designed and implemented a learner-centered network teaching platform based on a combination of Moodle and Wiki in the mobile cloud computing environment. Learners are able to access all functions, which are provided by the network teaching platform, through the mobile terminal anytime and anywhere, sharing and downloading teaching resources efficiently and reliably through the cloud storage service as the performance evaluation shows. The platform can also reduce the economic cost significantly. The traditional teaching pattern of university courses is quite simple. It mainly uses the knowledge dissemination model that is classroom lecturing, asking questions, assigning homework, etc. Most students have no interest or initiative in learning and, thus, cannot exercise their innovation and practical ability effectively. The key issue of university course reform is how to improve students’ interest and initiative in learning, how to make them to understand courses’ principles and content effectively, how to enhance their innovation and practical abilities, and how to enable them to apply knowledge to actual projects, in order to satisfy the requirements of modern society and future work.

Mobile cloud computing into university teaching methods, which integrates some new technologies in the IT field, such as wireless mobile networks, cloud computing and multimedia technology, and they propose an innovative method to achieve mobile learning, by which cloud services can provide ample education information and resources, while students can access them through portable mobile devices (like Smartphone, PDA, laptop, etc.), and communicate with teachers and other students anytime and anywhere. This learning method gets rid of time and space limits, and makes students more active. Student also surely enjoying this method.[20][21]

To support such a learning method, the authors designed and developed a new network teaching platform, which focusses on learners, supports various types of portable mobile devices, and has been constructed on some important Web 2.0 applications (Moodle and Wiki) and in a cloud computing environment.

Moodle

Moodle is a kind of network learning management system, which has been popular in recent years. Since it is free, open source and easy to operate, it has been recognized by many education experts. Moodle’s full name is modular object-oriented dynamic

learning environment. Its design is based on a social construction theory of education that allows teachers or students to think together and work cooperatively to achieve collective wisdom and collective knowledge. It is software that is used to construct a course learning Web site based on the Internet, and it covers the management of the whole teaching process to create a modularized and object-oriented dynamic learning environment with courseware, blogs, resource libraries, etc. On the one hand, Moodle sets up various course activities for teachers, such as f, tests, votes, questionnaires and chat. Teachers can arrange teaching activities flexibly to match the teaching strategies and keep abreast of students' learning situation accurately to give guidance to students. On the other hand, the teaching design and management of Moodle are student-centered, and are suitable for personalized learning and collaborative learning between individuals. It can improve students' innovative and practical ability enormously. [17][18]

Wiki

Wiki is a co-creation system and is maintained by many people cooperatively, in which everyone can give opinions or discuss and expand their common topics [19]. Specifically, Wiki is a kind of hyper-text system. One can browse, create, edit and publish the Wiki contents on the Web. The cost of operating on Wiki is far less than that of HTML. Meanwhile, Wiki supports community-oriented collaborative writing, offering necessary help for writers.

X. CONCLUSION

Mobile Cloud computing (MCC) is one of the mobile technology trends in future since it combines the advantage of both mobile computing and cloud computing, With the importance, this paper has provided an overview of mobile cloud computing in which its definitions, architecture and advantages have been presented. Mobile Cloud Computing it can supported in various application Such as m-

Commerce, m-Learning, HMCC etc. are discussed These are upcoming trends in Mobile Cloud Computing and its very useful application so people can using this application anywhere anytime and mainly it can be supported all platforms.

This paper is mainly focus on the research of Application Mobile Cloud Computing and its Upcoming trends what Areas it will Used.

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