

A Comprehensive Study on MCC (Mobile Cloud Computing) Architecture, Challenges and Benefits

Dr. Mukesh Chandra Negi
Project Manager, TechMahindra Ltd.
PhD, MCA, M.Sc., APGDCA, PGDCA, CIC
Mukesh_negi77@yahoo.com, Mukesh.negi0910@outlook.com

Abstract: Cloud computing is a technique where based on cloud delivery model, your complete or partial IT infrastructure and applications are managed by some third party cloud service provider or you just have to subscribe for the services you wanted to use if it's completely managed and own by the provider. It's helpful especially where you have a requirement of high efficient resources like memory, processor, CPU, storage etc with costing constraints. Seeing the growth of smart mobile devices in last few years, it has been realized to identified and develop a rich application platform for mobile devices to gain the benefits of cloud computing in mobile devices. Mobile Cloud Computing (MCC) concept has been developed realizing the same and it's a great concept and platform to leverage the benefits of cloud computing with mobile devices [1] [2]. It's a concept where some thin mobile client applications developed for the mobile devices and all backend processing workload offloaded to the cloud environment, which execute the user requirements and send back results to the user mobile device thin application. In this paper I am going to explain basic and high level architecture, challenges and benefits of mobile cloud computing concept and technology.

Keywords: Cloud Computing, MCC, Mobile Cloud Computing, Mobile Computing, Mobile and Cloud

I. INTRODUCTION

Mobile cloud simply defined as, it's an internet based applications, data and all other related services which you can accessed via mobile, laptop, pc, tablets and other portable devices [2]. Difference between mobile computing and mobile cloud computing is, on mobile computing some native applications runs on you mobile device which use all of your mobile resources to execute the application however in mobile cloud computing only a very thin application run on your mobile device which offload all of the data and processing to the backend cloud computing environment. Mobile is running mix kind of applications, native and cloud both however the trend is moving towards the mobile cloud based. As of today now mobile is an essential part of our life and lots of stakeholders from IT industry are working to provide us more rich and efficient mobile experience within the limitations of the mobile devices. This is one of the big challenges where user expectations in terms of mobile applications usability are very high however mobile devices are still struggling with the limited capacity of resources. Especially when it's comes to accessing and processing of enterprise applications, heavy data, videos and images from the mobile devices. High user expectations, Limitations with mobile device resources and internet bandwidth are the big challenges in the field of mobile computing, and this is the reason IT diverted towards mobile cloud computing to offload high computation power requirements to cloud computing. In this paper I will explain about the basic architecture, challenges and benefits of mobile cloud computing [3].

There was a survey conducted by the IBM developerWorks on most significant enterprise technology and industry trends between 2000 developers across 87 countries, and almost more than 55% of developers expected that mobile cloud

Applications development will surpass the development of other traditional computing platforms in near future.

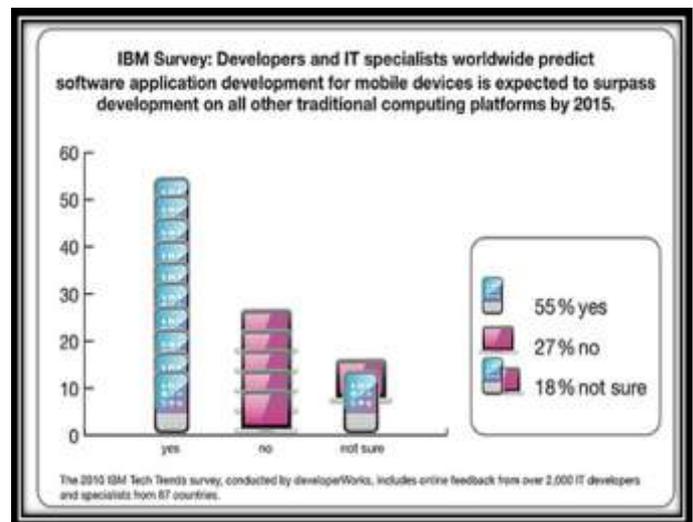


Fig 1 – IBM Survey report on future of mobile application development [3]

Below figure shows the growth of mobile cloud computing revenue growth by region business segment, world market, forecast 2009 – 2015 conducted by AIB research.

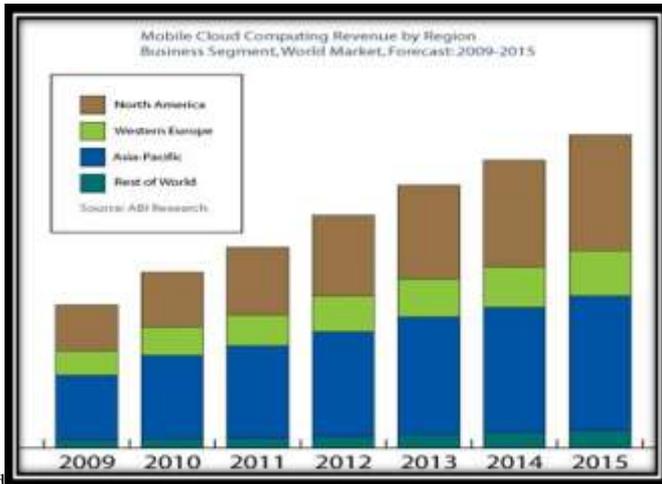


Fig 2 – AIB cloud computing development region wise revenue growth

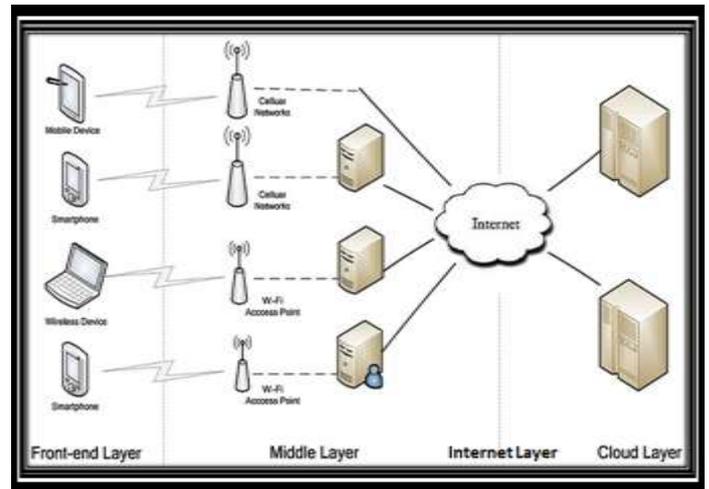


Fig 3 – Basic Architecture of Mobile Cloud Computing

According to AIB research prediction, cloud mobile enterprise business will reach around \$3.6 billion by 2019, and in next five years the development of mobile cloud computing will take precedence over on premises development and implementation.

Below is another basic figure which shows different set of applications in your mobile device [7]. You get all the services from your mobile operator and it's your mobile operator who actually send and get response back to you from different backend cloud service providers otherwise it can be directly between your device, ISP and cloud service provider depend on architecture.

II. MCC ARCHITECTURE

A very basic architecture of mobile cloud computing is shown in fig 1 below. There are four major stakeholders involved in the complete architecture for end to end service delivery.

- Mobile Device or User
- Mobile Network Operators
- Internet Service Provider (ISP)
- Cloud Service Provider.

Mobile device user is an end user who is actually using mobile cloud applications via handset, Mobile Network Operator is the telecom operator who is providing mobile voice and data services to end user and finally at last will serve cloud services as well (not necessary in direct cloud services access via ISP), ISP will be provide the internet service and Cloud service provider the vendor who is providing the cloud services [5] [6].

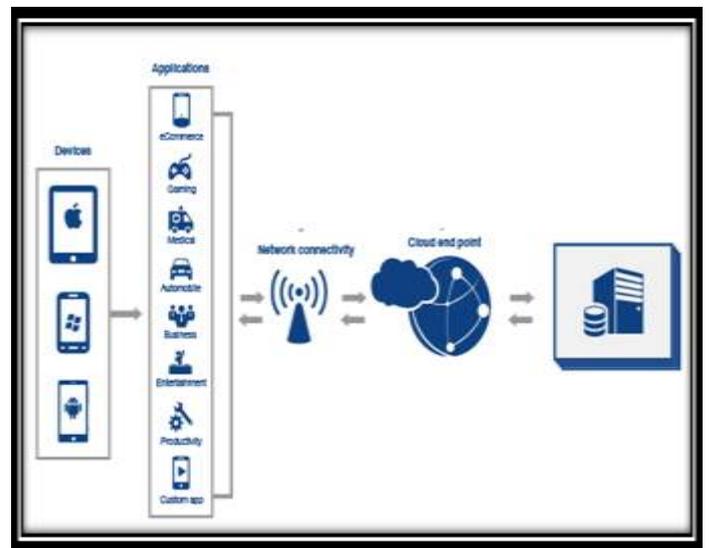


Fig 4 – Basic End User Device Mobile Cloud Architecture

Below is the basic four layer architecture of Mobile Cloud Computing. First is the mobile device layer from where users access the applications, middle layer is the mobile operator infrastructure, third is internet layer and fourth is Cloud service layer.

There are actually two sides of mobile computing. One side is the traditional private cloud model where different organizations runs their all IT infrastructure in their own on premises or third party private cloud environments, and access applications via mobile device browsers. Another side you can call as mass market mobile cloud where some more stakeholders involved providing benefits of mobile and cloud services to large public. There you have different MNO (Mobile Network Operators) like AT&T, Vodafone, Orange, Airtel, CNSP's (Cross Network Service Providers) etc and actual cloud service providers including ISP's and mobile devices. In earlier trends, smartphone users were to limited and fix number of applications that their carrier providers were providing in associations with the cellular company, for example AT&T and apple. Mobile applications are dependent

on the mobile operating systems and few more other features of mobile, and mobile cloud computing is the great innovation in this area where you don't have any dependency on any mobile OS or mobile network cell operators to use your applications. In mobile cloud computing you can access your applications using any device or services of any mobile network operator, it's Cross Network Service Providers who actually take care of traffic diversion in case any service is required from another network operator [5].

Below is the high level architecture of Mobile Cloud Computing. All mobile device applications connected to cloud services via their mobile network operator. Request from end users mobile devices reach to mobile operator from different access points, local network base stations and satellites. Mobile operator check for the user requests and based on user authorization and access policies diverted the requests to backend respective cloud service providers and deliver results back to the end users mobile device [8] [9].

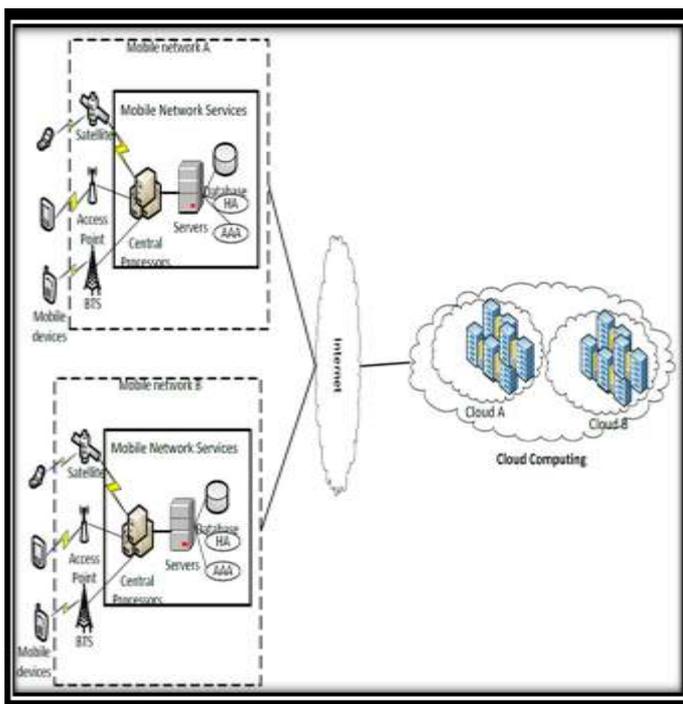


Fig 5 – High Level Mobile Cloud Computing Architecture [4]

III. MCC BENEFITS

As I have explained above and shown in different surveys on mobile cloud computing, the growth of mobile cloud computing consistently growing and it is expected to grow in a great manner in future as well. Below are some high level benefits of adopting the Mobile Cloud Computing [12].

A. It allows large market access to the developers since there is no dependency of the application on any operating system mobile network operators.

B. Mobile cloud applications accessed via mobile browser so mobile device O.S does not affect other mobile applications and also allow developers to bypass lots of O.S related restrictions.

C. Developers don't require to developed different applications for different mobile devices because complete data exist and processing happened at backend cloud service environment.

D. There is no need of a highly configuration devices as required in native application devices since all workloads and processing are offload to backend cloud.

E. It save's the end user costs as well increase the efficiency and performance.

F. There is no need of very expensive high configuration hardware's to run complex applications run in mobile cloud which save cost and complexity.

G. It increases the life of battery of mobile device since all heavy processing offloaded to backend cloud resources.

H. High storage capacity in mobile devices is also one of the big challenges. With mobile cloud computing you can take the benefit of cloud high storage capacity.

I. Reliability is increased as data and applications are backed up properly on multiple cloud computers with high availability and failover configurations.

J. You can do the dynamic provisioning of resources as soon as users increased

IV. MCC CHALLENGES

Despite of lots of advantages there are still lots of open challenges related with mobile cloud computing. Below are some current high level challenges [12] [13].

A. Security is one of the major concerns as complete data resides on third party cloud service provider, as well as communications and data transfer happened over public networks and sometimes over less secure public network.

B. Software must have to run multiple operating stems those undergo under updates frequently.

C. Intermittency and continuous availability of network is also one of the major concern since mobile cloud applications required continuous connectivity with the network

D. Distribution of software's. Enterprise should have to consider about download store if they have to create their own to ensure end users only download approved enterprise mobile applications only.

E. Developers are still working on caching and many more concepts for fast processing of applications in low bandwidth network areas.

F. Lack of mobile cloud computing standard also making it challenging.

G. Mobile signal and strength in all areas is also one of the big challenges.

H. Ensuring QoS is also a big issue specially on network delays.

I. Uncertainty on lots of issues like pricing, billing, SLA's, Term & Conditions etc. due to multi-level involvement of different interconnected stakeholders.

J. Interoperability as same application has to run on different multiple devices and operating systems.

V. CONCLUSION

Mobile cloud computing is a technology which combines the feature of mobile as well as cloud computing technology. No doubt it's a great innovation and era in the field of mobile computing to get great benefits where you can offload your high resource requirement to cloud. According to various surveys of different independent research firms like AIB, Gartner etc, the growth and business of mobile cloud computing is expected to get double figure almost in each alternate year due to tremendous research in the field of smart mobile devices. Considering the facts and importance of same, My this article has provided a detailed explanations on low and high level architecture of mobile cloud computing as well as all related benefits and challenges for the students and research scholars whoever wanted to understand and do the research in the field mobile cloud computing.

REFERENCES

- [1] Ms. Snehal P. Warhekar, Prof. V.T. Gaikwad, Mobile Cloud Computing: Approaches and Issues, <http://www.ijettcs.org/Volume2Issue2/IJETTCS-2013-04-23-151.pdf>
- [2] [Http://searchcloudapplications.techtarget.com/definition/mobile-cloud](http://searchcloudapplications.techtarget.com/definition/mobile-cloud)
- [3] IBM Survey: IT Professionals Predict Mobile and Cloud Technologies Will Dominate Enterprise Computing By 2015, <https://www-03.ibm.com/press/us/en/pressrelease/32674.wss>
- [4] https://commons.wikimedia.org/wiki/File:Mobile_Cloud_Architecture.jpg
- [5] <http://searchcloudcomputing.techtarget.com/tip/Enterprises-usher-in-mobile-cloud-computing>
- [6] Davies, "The case for vm-based cloudlets in mobile computing," Pervasive Computing, IEEE, vol. 8, no. 4, pp. 14-23, 2009.
- [7] X. Zhang, S. Jeong, A. Kunjithapatham, and Simon Gibbs, "Towards an Elastic Application Model for Augmenting Computing Capabilities of Mobile Platforms," in The Third International ICST Conference on Mobile Wireless Middleware, Operating Systems, and Applications, Chicago, IL, USA, 2010.
- [8] C. Doukas, T. Pliakas, and I. Maglogiannis, "Mobile Healthcare Information Management utilizing Cloud Computing and Android OS," in Annual International Conference of the IEEE on Engineering in Medicine and Biology Society (EMBC), pp. 1037 - 1040, October 2010

[9] Chetan S, Gautam kumar, K. Dinesh, Mathew K. and Abimanyu M.A "Cloud computing for mobile world" national institute of technology, calicut.

[10] G. D. Fabbriozio, T. Okken, and J. G. Wilpon, "A speech mashup framework for multimodal mobile services," in Proceedings of the 2009 international conference on Multimodal interfaces (ICMI-MLMI), pp. 71-78, November 2009

[11] S. Yang and C. Hsu, "An ontology-supported ubiquitous interface agent for cloud computing-Example on Bluetooth wireless technique with Java programming" in International Conference on Machine Learning and Cybernetics, pp. 2971-2978, September 2010

[12] W. Itani, A. Kayssi, and A. Chehab "Energy-Efficient Incremental Integrity for Securing Storage in Mobile Cloud Computing" in Proceedings of the First Annual International Conference on Energy Aware Computing, December 2010

[13] X. Yang, T. Pan, and J. Shen, "On 3G Mobile E-commerce Platform Based on Cloud Computing," in Proceedings of the 3rd IEEE International Conference on UbiMedia Computing (U-Media), pp. 198 - 201, August. 2010.