

Mobile Cloud Computing: A Review

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ABSTRACT

In today's world, the swift increase of utilizing mobile services and simultaneously discovering of the cloud computing services, made the Mobile Cloud Computing (MCC) selected as a wide spread technology among mobile users. Thus, the MCC incorporates the cloud computing with mobile services for achieving facilities in daily using mobile. The capability of mobile devices is limited of computation context, memory capacity, storage ability, and energy. Thus, relying on cloud computing can handle these troubles in the mobile surroundings. Cloud Computing gives computing easiness and capacity such provides availability of services from anyplace through the Internet without putting resources into new foundation, preparing, or application authorizing. Additionally, Cloud Computing is an approach to expand the limitations or increasing the abilities dynamically. The primary favourable position of Cloud Computing is that clients just use what they require and pay for what they truly utilize. Mobile cloud computing is a form for various services, where a mobile gadget is able to utilize the cloud for data saving, seeking, information mining, and multimedia preparing. Cloud computing innovation is also causes many new complications in side of safety and gets to direct when users store significant information with cloud servers. As the clients never again have physical ownership of the outsourced information, makes the information trustworthiness, security, and authenticity insurance in Cloud Computing is extremely difficult and conceivably troublesome undertaking. In MCC environments, it is hard to find a paper embracing most of the concepts and issues such as: architecture, computational offloading, challenges, security issues, authentications and so on. In this paper we discuss these concepts with presenting a review of the most recent papers in the domain of MCC.

KEYWORDS: Cloud Computing, Mobile Cloud Computing, MCC, Energy Efficient, Mobile Network, Offloading.

I. INTRODUCTION

In the course of recent years, progresses in the context of information technology (IT) have driven the world to advance toward network based computing. An ever increasing number of clients are requesting applications and services on the Internet. This enormous development and application request has driven the prologue to an idea of cloud computing. Hence, Cloud computing brings another period of advancement of the Internet, which incorporates the arrangement of use services, programming administrations, and Hardware utilities on the Internet. In specialized words, cloud computing is a bunch of servers or PCs gathered with each other to give specified services on the Internet [11].

The phrase mobile cloud is commonly pointed to in two perceptions: "(A) infrastructure based, and (B) ad-hoc mobile cloud". In the infrastructure based mobile cloud, the equipment infrastructure stays static which are hardware parts and it serve the mobile clients. Then again, ad-hoc mobile cloud alludes to a gathering of mobile gadgets that go about as a cloud and gives access to local or Internet based cloud that serves other mobile gadgets. The traditional calculation offloading strategies can't be utilized for the mobiles specifically in light of the fact that these systems are for the most part vitality unconscious and transfer bandwidth greedy. Also, the traditional mobile application productions support the improvement of utilizations that can execute just on mobile gadgets without computational offloading [12]. See Fig. 1 illustrates the architecture of the mobile cloud computing.

In the midst of mobile cloud computing, we go ahead one more stride along thusly; the dynamic and convenient nature of mobile gadgets is consolidated with the adaptable asset pooling of cloud computing worldview. The calculation and communication escalated operations are offloaded to the cloud, liberating the mobile gadget from

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its inherent confinements. MCC is a computing worldview which causes the mobile gadget to get to and prepare petabytes of information and run calculation concentrated applications which generally would have been incomprehensible because of the impediments of the gadget [14]. This paper review the resent papers in mobile cloud computing and the common concepts and issues in its context. The rest of the paper is structured as follows: in

section II we reviewed the most recent papers in this domain. In section III we illustrate the meaning of Cloud computing and mobile cloud computing. In section IV we illustrated the architecture of MCC, and then the advantages and the challenges of MCC are argued in section V and VI In sequence. Finally, we concluded in section VII.

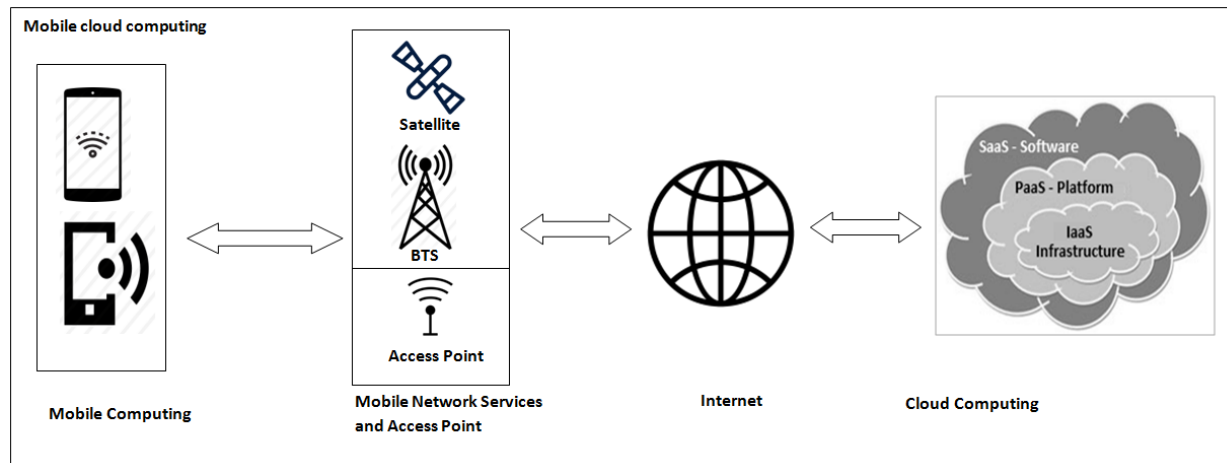


Fig.1 Mobile Cloud Computing Architecture

II. LITERATURE REVIEW

In this section we reviewed resent papers that they discuss different issues in Mobile Cloud Computing (MCC).

In [1] the concentration is on analysing security issues in Mobile Cloud Computing (M2C). A generic model is initially described for M2C that relies on utilizing case scenarios description. Next, the security intimidations are evaluated faced to the proposed model. This will be helpful for indicating the collection of security needs to frustrate the attacks and security threats. Additionally an observation is argued regarding to the model.

In [2] a middleware is suggested for making choices and adjusting cloud services consistent with recent user's context, it collects context of data as of mobile gadgets, such as location. Next, a service is chosen regarding to the accessible cloud services and clients' desires. In addition, the client's acceptable cost is consumed which provides more precise information to make a enhanced selection of the service supplier. Moreover, in this paper, the architecture of middleware is provided with the explanation of the interaction among its modules. Finally, an experiment is presented to assess the suggested middleware.

In [3] the most common problems in Mobile cloud computing is discussed with presenting the related works in this field. The duty is organized into three offloading operation types: anchored in a client-server communication, virtualization, or else various arranged mobile agents, converse in brief every one's benefits / drawbacks and provide paradigms of some operations. After that, a little of papers' influence is assigned for utilizing mobile-devices as the source meant for an ad-hoc cloud computing. The last part of the paper states a

substitute Map-Reduce based method for structure a virtual cloud computing supplier, one's benefits/drawbacks, and instances of operations.

In [4] a "multisite computation offloading solution" is presented in mobile cloud computing surroundings by the way of public and clouds as well as cloudlets. The projected method utilizes the genetic algorithm for discovering a sufficient offloading clarification in a appropriate mode. The process of initialization the population, selection techniques, generation making through the crossover mechanism, and mutation process are organized as a result the possibility of meet to the global best enhances. The experimental result illustrates that the proposed solution outstrips the recent literatures regarding to both implementation time and energy expenditure.

In [5] indicated that "Tsai and Lo's PAA" method is susceptible to a crucial attack and is unable to maintain client secrecy. To crack such crucial faults, the paper suggested a new PAA system designed for MCC utilities. Security investigation demonstrates that the suggested PAA system be able to crack the security trouble belonging to "Tsai and Lo's PAA" method. Besides, the performance analysis shows that our proposed PAA scheme has better performance than their PAA scheme.

In [6] the most selectable offloading form is offered that breaks up an application into many duties and offloads the divided applications on the origin of their features and implementation pattern. The offloading farm that is recommended includes the origins of the main principles belonging to Mobile Cloud Computing. Throughout application offloading the projected form obtains into deliberation the communication charge during to the implementation charge of operating a duty on cloud.

Duties operating on cloud or internally on the mobile gadget are in fully sync with each other and swap information that could perform like inputs for one and output for the other.

In [7] a mobile agent is suggested to optimize big quantity data broadcasting for mobile users in mobile cloud computing. This agent provides a helpful gate for decreasing energy exploitation and decline waiting time. The agent optimization technique is applied as well as performed some experimentation on Android platform. The tentative consequence points that the proposed system does considerably develop energy effectiveness and performance for huge quantity of data broadcasting in mobile cloud computing.

In [8] a new design of energy optimization technique is proposed for Mobile Cloud Computing (MCC) named "Organic Mobile Cloud Computing". This scheme permits other methods to be remarked and offloaded involuntarily to Cloud Servers. The technique also clarify precedent schemes to these troubles that depended greatly on programmer sustain to separate the application, they do not obtain into deliberation the enormous computation owing to permanent profiling. Moreover, The proposed scheme happens at runtime, that techniques have to be run distantly from the list of techniques involuntarily remarked, for this, organic computing schemes is employed to generate optimum results.

In [9] stated that generally cloudlet based contributions depend on the selection of a single resource for offloading that provides appropriate network circumstance and elevated computing abilities. The accomplishment of the identified cloudlet could humiliate after a while, as a result guides to the make selection again of another one to complete flawless service stability. the paper suggested to gain benefit of making selection of two cloudlets; the first one is to certify appropriate network connection and the second one is to certify elevated performance execution of the application so as to maintain the mobile user "Always Best Connected and Served" (ABC&S) happening in both stages: network and cloud. Initial consequence confirms the effectiveness of the proposed method in preserving a realistic response time contrast to other schemes based just on latency parameter for selection.

In [10] the "mobile application offloading" is studied for mobile cloud computing. For eliminating the energy utilization of mobile gadgets, a user might offload the mobile applications to access cloud servers. Nonetheless, offloading applications to cloud servers earns additional time for executing the mobile applications. To steadiness the exchange between the energy utilization by the mobile gadgets and the execution delay by the mobile applications, a "novel optimization problem" is invented, which reduces the total of energy utilization and delay consistent with an assured weightage. At the beginning, is confirmed that the described trouble is NP-hard. For a particular manner with infinite energy ability of mobile gadgets and the equal volume of the resources is necessary to perform all mobile

applications, they suggested a polynomial-time best result, that is initiated on bipartite corresponding trouble. Next, they have proposed a proficient heuristic technique in support of the universal manner of the trouble.

III. CLOUD COMPUTING AND MOBILE CLOUD COMPUTING

In this section we are discussing the meaning of the concepts of Cloud computing and mobile cloud computing.

A. Cloud Computing

Cloud computing alludes to both the applications conveyed as utilities over the Internet and the hardware and system software through the datacenters that give those utilities. A bunch of PC hardware and software that propose the utilities to the overall population constitutes a 'public cloud'. Computing is in this manner proposed as usefulness much like power, water, gas, and so forth wherever you just pay for each utilization. For instance, "Amazon's Elastic cloud, Microsoft's Azure platform, Google's App Engine and Salesforce" are some public clouds that are accessible today. In any case, cloud computing does exclude 'private clouds' which points to "datacenter" to an association. Hence, cloud computing can be characterized as the total of computing as a helpfulness and software as a utility. Virtualization of assets is a key prerequisite for a cloud supplier—for it is required by statistical multiplexing that is needed by versatility of the cloud and furthermore to make the fantasy of vast assets to the cloud client. To acquire a case as of the current cloud suppliers, an example of "Amazon's EC2" is especially similar to a physical machine and provides the cloud client satisfied permission of the software heap through a slight API. This provides the client lots of adaptability in coding; nonetheless, it likewise implies that Amazon has minimal programmed versatility and collapse alternatives. Interestingly, "Google's App Engine" implements an API on the client however provides great programmed adaptability and collapse alternatives. Microsoft's Azure stage is something in the middle of the previously mentioned suppliers by providing the client several decisions to select in the language and provides fairly programmed extent and collapse occupations. All of the previously mentioned suppliers have diverse alternatives for "virtualizing computation, storage, and communication" [14].

B. Mobile Cloud Computing (MCC)

There are some existing meanings of mobile cloud computing, we will introduce some of them. Usually, the term mobile cloud computing intends to run an application, for example, Google's Gmail for Mobile on a remote asset rich server, while the mobile gadget goes about as a thin customer interfacing over to the remote server through 3G. Some different cases of this sort are Facebook's area mindful services, Twitter for mobile, mobile climate gadgets and so on. Another approach is to consider other mobile gadgets themselves too as asset

suppliers of the cloud making up a mobile peer-to-peer network. Along these lines, the aggregate assets of the different mobile gadgets in the neighborhood region, and other stationary gadgets too if accessible, will be used. This approach underpins client versatility and perceives the capability of mobile clouds to do aggregate detecting too. Peer-to-peer frameworks, for example, SATIN for mobile self-sorting out exist, however these depend on part demonstrate frameworks speaking to frameworks made up of interoperable neighborhood segments as opposed to offloading employments to nearby mobile assets. The cloudlet idea proposed by Satyanarayanan is another way to deal with mobile cloud computing. The mobile gadget offloads its workload to a nearby "cloudlet" contained a few multi-center PCs with availability to the remote cloud servers. Fitting Computers can be viewed as great contender for cloudlet servers as a result of their frame factor, differing qualities, and low power utilization. They have an indistinguishable general engineering from a typical PC, however are less capable, littler, and more affordable, making them perfect for part little scale servers introduced in the general population framework. These cloudlets would be arranged in like manner territories, for example, cafés with the goal that mobile gadgets can interface and capacity as a thin customer to the cloudlet rather than a remote cloud server which would show inactivity and transfer speed issues [11] [12] [14].

IV. MOBILE CLOUD COMPUTING ARCHITECTURE

In the present mobile cloud architecture, mobile gadgets can access cloud benefits in two routes, i.e., through mobile network or through access points, as appeared in Fig1.

In the mobile network case, the mobile gadgets, for example, cell/satellite cell phones are associated with a mobile network through a Base Station (BS) or by means of a satellite link. Be that as it may, if the cell phones are not furnished with a satellite correspondence module, at that point outside satellite specialized gadgets are utilized. The telecom networks are additionally associated with the Internet and give Internet availability to the clients. Along these lines, if the clients have mobile network availability, the clients can access cloud based administrations through the Internet. In the access point case, the mobile clients interface with the access points through Wi-Fi that is additionally associated with the Internet specialist organization to give Internet network to the clients. Along these lines, the mobile cloud clients are able to admission cloud services lacking of using telecom administrations, this might indict them for information activity. Besides, Wi-Fi based associations give little idleness and devour fewer vitality contrasted with 3G associations. Therefore, mobile cloud clients want to utilize Wi-Fi Internet associations at whatever point accessible-[11] [12] [14].

V. ADVANTAGE OF MOBILE CLOUD COMPUTING

Cloud computing is recognized to be a talented solution for mobile processing because of a lot of causes. In the accompanying, it portrays how the cloud can be utilized to

defeat hindrances in mobile computing, thus indicating advantages of MCC.

a. Expanding Battery Lifetime

The battery is one of the major subjects for mobile gadgets. Some arrangements are proposed to enhance the CPU implementation as well as to administer the diskette an intelligent mode for eliminating power consumption. Nonetheless, these solutions need modifies through construction in mobile gadgets, or they need hardware that results in an increasing the cost and it is impossible for each single mobile gadget. The offloading procedure is offered by means of the goal to move the vast calculations as well as compound computing as of asset restricted gadgets (mobile gadgets) to ingenious machines (servers in clouds). This refrains to have an extended application implementation time on mobile gadgets because this produce lot of energy consumption. The result shows that the distant application implementation has ability to maintain energy considerably [8] [12].

b. Enhancing data storage ability and processing power

Storage ability is additionally a limitation for mobile gadgets. MCC is produced to empower mobile abuser to store/get to the vast information on the cloud through wireless networks. The primary illustration is the Amazon Simple Storage Service (Amazon S3) which bolsters record storage benefit. Mobile snap sharing service allows customers to transfer pictures to the clouds instantly subsequent to catching. Thus the users are able to get all pictures from any device. In the cloud, the clients have ability to keep a lot of capacity and energy on their mobile gadgets as every picture is sent and handled in clouds. Facebook is the most excellent informal community application in nowadays, and it is as well a run of the mill case of utilizing the cloud in sharing pictures. Cloud computing can productively bolster different assignments for information warehousing, overseeing and synchronizing numerous reports on the web. Mobile applications likewise are not obliged by storage limit on the gadgets in light of the fact that their information now is put away in the cloud [8] [12].

c. Enhancing reliability

Putting away information or running applications on clouds is a successful approach to enhance the reliability since the application as well as the data are amassed moved down in a variety of computer systems. This diminishes the possibility of information and application lost on the mobile gadgets. Furthermore, Mobile Cloud Computing is planned like an extensive security data packet display for both specialist co-ops and clients. For instance, the cloud may operate to protected copyrighted advanced materials (such as: videos, snips, and sound files) as of being bundle with unapproved dispersion. Additionally, the cloud may distantly furnish to the users with security utilities, such as, infection checking, malevolent code location, and

validation. Likewise, such cloud-based services of security have ability to make proficient exploitation of the collected record as of diverse users to develop the feasibility of the services [8] [12].

Additionally, there are some more advantages that Mobile Cloud Computing takes of clouds such as: simplicity of Integration, Multi-tenancy, Scalability, Dynamic provisioning, and so on.

VI. CHALLENGES IN MOBILE CLOUD COMPUTING

Several difficulties are confronted in mobile cloud computing; a portion of the essential ones are talked about in this section.

d. Network Latency

Mobile cloud computing confront troubles caused by the network latency, due to the constraints and restricted bandwidth of the wireless networks. Some applications, video game, and concurrent applications for video calls have need of least amount of network latency and dependable bandwidth [11].

e. Security and privacy protection

This is an exceptional issue and the investigations are still in the essential level. Main matters for computational offloading in MCC are the insurance of area data and other individual touchy data of clients. The information put away in the cloud might be perused by the cloud specialist co-op without the learning of information proprietor. Moreover, the cloud supplier may not be trusted by all methods and there is an extensive possibility of information being caught by an unapproved client in spite of the security measures attempted by the cloud supplier. In this way, it is a test to understand the security and privacy assurance of clients for computational offloading in MCC [11] [15].

f. Various access mechanisms

The majority of the network systems are varied in nowadays. They are sent with different advances, for example, 3G, Wi-Fi, Wi-Max and so on. Mobile cloud computing needs to be always-on, even on-demand accessible remote connections with adaptable bandwidth and vitality productive gadgets [11].

VII. CONCLUSION

Mobile cloud computing is a rising and quickly developing field of cloud computing. The goal of this innovation is to utilize services, storage space, or applications on the cloud by mobile gadgets. Mobile cloud computing will give advantage to clients and undertakings all-round the world. The quantity of mobile clients has been expanded radically since couple of years, the number of utilizations have been increased for mobile applications. Even though mobile cloud computing provides many points of interest and convenience of services on mobile gadgets, notwithstanding, many difficulties are been confronted by this innovation. In this paper, we reviewed the recent researches associated with Mobile Cloud Computing.

Firstly, we illustrate the concepts of Cloud computing and then utilizing this technique for mobile devices. Second, we reviewed most recent papers associated with this Mobile Cloud Computing. After that we discussed the meaning of cloud computing and mobile cloud computing. The architecture of Mobile Cloud Computing is also presented. Finally, we discussed the advantages and challenges of mobile cloud computing.

REFERENCES

- [1] A. H. Gamlo, N. Zhang, and O. Bamasag, "Mobile Cloud Computing : Security Analysis," IEEE Int. Conf. Mob. Cloud Comput. Serv. Eng. Mob., 2017.
- [2] H. Bangui, S. Rakrak, and S. Raghay, "Selecting Location-based services in mobile cloud computing," 2016 11th Int. Conf. (pp. 1-5). IEEE, 2016.
- [3] C. Barca, C. Barca, C. Cucu, O. Fratu, and S. Halunga, "A Virtual Cloud Computing Provider for Mobile Devices," 2016 8th Int. Conf. (pp. 1-4). IEEE., 2016.
- [4] M. Goudarzi and Z. Movahedi, "Mobile Cloud Computing : A Multisite Computation Offloading," 2016 8th Int. Symp. (pp. 660-665). IEEE, pp. 660-665, 2016.
- [5] D. He, N. Kumar, M. K. Khan, L. Wang, and J. Shen, "Efficient Privacy-Aware Authentication Scheme for Mobile Cloud Computing Services," IEEE Syst. J., pp. 1-11, 2016.
- [6] A. Khanna, A. Kero, and D. Kumar, "Mobile Cloud Computing Architecture for Computation Offloading," Next Gener. Comput. Technol. (NGCT), 2016 2nd Int. Conf. (pp. 639-643). IEEE, 2016.
- [7] X. Li and Q. Li, "DTM: a new data transmission method in mobile cloud computing ," Adv. Cloud Big Data (CBD), 2016 Int. Conf. (pp. 252-257). IEEE, pp. 252-257, 2016.
- [8] S. Nadouri and H. Fellah, "OMCC : Organic Mobile Cloud Computing," Model. Identif. Control (ICMIC), 2016 8th Int. Conf. (pp. 169-173). IEEE, pp. 169-173, 2016.
- [9] H. Ben Saad, M. Kassar, and K. Sethom, "Always Best Connected and Served based Scheme in Mobile Cloud Computing," Smart Cloud Networks Syst. (pp. 1-8). IEEE, 2016.
- [10] X. Wang, J. Wang, X. Wang, and X. Chen, "Energy and Delay Tradeoff for Application Offloading in Mobile Cloud Computing," IEEE Syst. J., vol. 1, pp. 1-10, 2015.
- [11] M. A. Amin and H. Al-Hashimi, "A Review of Mobile Cloud Computing Architecture and Challenges to Enterprise Users," GCC Conf. Exhib. (GCC), IEEE, pp. 240-244, 2013.
- [12] D. Dev and K. L. Baishnab, "A Review and Research towards Mobile Cloud Computing," Mob. Cloud Comput. Serv. Eng. (MobileCloud),

- 2014 2nd IEEE Int. Conf. (pp. 252-256). IEEE., 2014.
- [13] R. Khan, M. Othman, S. A. Madani, and I. Member, "A Survey of Mobile Cloud Computing Application Models," *IEEE Commun. Surv. Tutorials*, *Accept. Publ.*, pp. 1-21, 2013.
- [14] N. Fernando, S. W. Loke, and W. Rahayu, "Mobile cloud computing : A survey," *Futur. Gener. Comput. Syst.*, vol. 29, pp. 84-106, 2013, Elsevier, 2012.
- [15] Z. Zhang and S. Li, "A Survey of Computational Offloading in Mobile Cloud Computing," *Mob. Cloud Comput. Serv. Eng. (MobileCloud)*, 2016 4th IEEE Int. Conf. (pp. 81-82). IEEE., pp. 6-7, 2016.