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# Review of Offloading Approaches in Mobile Cloud Computing

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## INTRODUCTION

Mobile Cloud Computing is the combination of mobile computing and cloud computing, and has become most favorable words in the industry today and is a major hot topic discussion thread in the IT world since 2009. As the development of new applications on smartphones are increasing as so is the upgradation of the mobile device is required with bigger processing speed, extending battery life and improving performance. People wish to play games , watch movies and run excessive huge applications on their device which takes more processing time also reduces battery of the device. Thus in all reduces the overall performance of the mobile. To overcome all the issues a user may face, mobile computing has been introduced. Hardware changes on a mobile device comes with a restriction due to size and memory constraints and thus software can be changed by directing the processing done on the mobile device onto the cloud. As MCC is at the stage of development, it is important to understand the technologies completely of offloading data on to cloud . Until now Offloading is studied as the process of shifting the heavy application part on to the cloud to reduce burden on the mobile device.

The application can be partioned on the time of development or when execution is done. Until now, various models has been used for partioning the application and the fully automatic partioning of tasks at the time of execution is not done. In this paper review the different approaches of offloading in cloud and mobile by different cloud system like cloud sim,EC2,Red cloud etc. and it's effect on energy, time and cost.

## LITERATURE SURVEY

Meng-Hsi Chen†, Ben Liang†, Min Dong‡ [1] **:** This paper proposes an well planned model with new offloading algorithm by semidefinate relaxation and a novel randomization mapping method. It consisted of the mobile computing scenario in which there are multiple independent tasks and one computing access point (CAP) along with one remote server. The access point can either compute the received tasks from the user or offloads them to the cloud .It improves the offloading decision of the user by minimizing weighted total cost of energy ,computation and delay to optimal offloading of tasks to the cloud by the user. Then the problem is formulated as a non convex quardratically constrained quadratic program, which is NP- hard in general. The problem is resolved by the proposed solution. The simulation results of the proposed model shows that it improves the performance with only small number of randomization iterations and when CAPs and a remote server is included it adds beneficial features in the traditional mobile computing system and improves computation performance.

Feng Xia · Fangwei Ding · Jie Li · Xiangjie Kong ·Laurence T. Yang · Jianhua Ma [2] **:** In this paper we device a Phone2Cloud ,a computation offloading system which offloads the computation of the application running on the mobile the user is using to the cloud and hence improving the energy efficiency of the smartphone and enhancing the performance of the application by reducing its execution time . It uses three key methods in the system proposed including CPU workload prediction in the resource monitor,bandwidth prediction in the bandwidth monitor and offloading decision making algorithm. The decision making for offloading is important as to decide whether the computation of application should or shouldn't be offloaded to cloud to save energy and application performance is improved. The energy efficient Phone2Cloud system proposed is semi-automatic uses two sets of experiments to prove the effectiveness of the proposed system and also takes advantage of computation offloading paradigm .

Huaming Wu, Qiushi Wang and Katinka Wolter [3] **:** In this paper the tradeoff between extending battery for the mobile and reducing the execution time is explored. The proposed scheme is adaptive and analysed on the results evaluated by the tradeoff analysis. In Cloud computing architecture three key components are used including resource monitoring ,cost and prediction models . The resource monitor analyses the CPU utilization, bandwidth, execution time of the application and the battery level. The prediction model depicts the prediction of process offloaded on cloud or processes locally. The main component is cost model where offloading decision is made which is based selected cost criterion.

In the proposed model when the program is called a tradeoff decision is made between time reducing and energy saving before the execution is done. While considering the economic

factor the execution time is divided in three intervals of never offload,tradeoff analysis and always offload based on critical values.
Resources are brought on demand due to elasticity of the cloud computing and the proposed model doesn't require estimation of the execution time . A server with critical value of speedup F for a specified smartphone is found on cloud. It satisfies the performance improvement and as important for Green It economic factor is considered .

Zhefeng Jiang and Shiwen Mao [4] **:** In this paper cloud offloading is a promising approach for the enhancement for computation and energy conservation. It proposes a Lyapunov optimization-based scheme for scheduling in cloud offloading , scheduling for cloud execution output is downloaded for multiple applications running on a mobile device with a multi core CPU. Online algorithm is derived and performance bounds are proved to the real time implementation for practical scenarios and it does not require stationary distribution of applications and any network conditions. Tradeoff between the average power consumption and average queue length which indicated the delay is done . The trace driven simulation results of proposed algorithm validates its performance finally.

Ashwin Ashok, Peter Steenkiste, †Fan Bai [5] **:** This paper offers the users to connect application to the internet which directs the computation on to the cloud of all the complex tasks run on board for execution to be efficient at the run time . A service oriented approach is proposed which helps to offload the remote execution of applications and data intensive tasks to the cloud and task functionalities are provided as services can be availed by the user of the application on the vehicle. It increases the user driving experience by limites computation of applications and resource storsge on vehicles . Embedded applications are upgraded once vehicles life cycle is increases.Through the experimental evaluation a prototype is implemented by two computer vision applications which uses the framework designed for offloading the computation from vehicle to the cloud during application run time. The approach provides at least 3x reduction in the end application response time .Adaptive offloading framework is designed where the network conditions are adapted during application execution in real vehicular driving environments. Results are evaluated and showed that there is an massive gain in application response time and services are also feasible based on offloading approach for adaptive cloud offloading. The execution time and storage on local machine is also considered and then profiling the results dynamically to show the performance increase.

Huaming Wu, Qiushi Wang and Katinka Wolter [6] **:** This paper tells us how the fast growing demand of cloud offloading has attracted many other fields to It industry to migrate their in house data over the cloud . This happens in medical field as well and a mobile health care system is developed which has two stages namely a cloud offloading and a sensor network. In the first stage the data is collected by body sensors is transmitted to remote mobile device for saving energy on the entire sensor nodes, thus called cooperative multi input multi output (MIMO).System is constructed for the data transfer where the sensor nodes indvidually cooperate with each other. In the second stage , two offloading schemes are proposed.The proposed system is further analyzed on the basis of service topology and optimal graph partition. Tradeoff between the stability and communication is done . Both the schemes can be applied to other scenarios for performing offloading on multiple servers. Through the proposed system patients can know about their health information and also the risk factor of chronic diseases in future.

Roopali, Rajkumari [7] **:** This paper mainly dicusses the process of offloading, what all issues occur when a huge application is run on a smartphone and offloaded on the cloud. It shifts all the complicated part on to the cloud which can be done either at the time of development or when execution is done .It basically discusses the latency rate issue which affects the application to be offloaded as distance between the code and the server increases. Another network bandwidth issue is stated which needs to provide user with required bandwidth to offload thus reduce efficiency. The solution proposed helps to solve migration cost and also assign tasks to the service providers present to execute the application on time.

Bowen Zhou, Amir Vahid Dastjerdi, Rodrigo N. Calheiros, Satish Narayana Srirama, and Raj Kumar Buyya [8] **:** Mobile cloud computing (MCC) provides services by bringing the abundant resources in cloud computing to the proximity of mobile devices so as to empower the mobile applications performance and conserve the battery life. One of the techniques adopted in mobile cloud computing is code offloading. In this paper context aware offloading decision algorithm is proposed providing the decisions at the run time when the medium and location is selected based on device context. Real experiments are conducted and performance of the algorithm is evaluated . the simulation results tell that the suitable medium and location is selected the performance of the device increases.
Karthik Kumar·Jibang Liu·Yung-Hsiang Lu· Bharat Bhargava [9] **:** This paper surveys that how offloading is done and how the huge complex data is computed on to cloud . The path of computation on to the remote servers and back to where application is running . They found how virtulization and mobile agents help in computation offloading . Various partioning algorithms and programs are discussed so as how computation offloading is increasing at massive rate and thus improve performace ans save energy.
Yating Wang and Ing-Ray Che [10] : This paper describes the need of converting the mobile computing to mobile cloud

computing . Various existing applications are studied and future technologies which can be helpful for the conversion of mobile computing to mobile cloud computing are surveyed. Different challenges faced such as scalability, elasticity, computation , security and task oriented services are discussed .In the last trust management techniques and various other approaches for future research are discussed.

## RESEARCH GAPS

In the review we come to know that the research done until now includes offloading of the task manually by the user which is not accurate everytime and also give less efficient results due to users inaccurate decision of offloading. Second gap analyzed can be formulated by maintaining the previous task information as it requires previous task knowledge for offloading. Third can be the prediction done by the prediction model which can be wrong if predication is not accurate thus leaves a gap. Another gap analyzes is that all the offloading decisions taken are the time of development but not at the run time. For successful offloading decision algorithm the decision should be made at run time of application. Models used in research does not completely fully automate the application to run and to offloaded tasks on the basis of cost and energy.

## CONCLUSION

We conclude with the high increasing demand of data computation on mobile devices and the capacity of data processing is considered as a strategic resource. Many applications on the devices are not accessible due to less storage or high computation of tasks . Mobile Cloud Computing (MCC) helps accessing all the applications constrained due to size battery or memory of the application by offloading the huge modules to the cloud .

We found that there are three main optimization approaches in MCC, which are focusing on the limitations of mobile devices, quality of communication, and division of applications services. Offloading of data is studied and various models are proposed reducing the cost , energy , response time and battery life by migrating the computation on the cloud. There is a gap analysed that there is no much work done to automatically partition the task to control energy, cost and response time of application together at the run time.

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