

# Mobile Cloud Computing Techniques: A Review

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**Abstract**— This paper presents the basic idea about Cloud Computing , Deployment models , Services models, Mobile Cloud Computing Basic model and architecture of Mobile Cloud Computing. Further in this paper the issues in Mobile Cloud Computing are discussed and the various ongoing researches have been discussed in the field of Offloading.

**Index Terms**— Cloud Computing, Mobile Cloud Computing , Smart phones, offloading, android.

## I. INTRODUCTION

### CLOUD COMPUTING

Cloud Computing is the use of computational resources (hardware and software) that are delivered as a service over a network. To fulfill the user's resource requirement such as storage, CPU, networks and memory , It makes a virtual pool of resource and provides on demand hardware and software. Cloud Computing works like distributed computing. In distributed computing , a huge or big problem can be divided into several small parts and distributed among various computers which execute individual part of problem and get the result. The final result comes by combining or integrating the individuals problem's result together. Cloud Computing portends a major change in how we store information and run applications. Cloud Computing has emerged as the great technology in terms of scalability and portability. It has changed our view of carrying data and communication.

Cloud is the collection or group of computers or servers interconnected with each other. Cloud is the network or say services provider. Clients can access resources from cloud through internet at anytime and anywhere[1]. Cloud Computing can have four types of Clouds called deployment models[2].

### Deployment Models

- i. **Private Cloud**:-Private Cloud is Cloud infrastructure operated only for a single

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organization. The cloud is either managed internally or by a third-party and hosted internally or externally. Users pay for the resources used by them i.e the cloud uses pay per use model. Only users of an organization can share data of private cloud for which it operated or build and third party sharing depends upon trust they build with them. Examples of private cloud include Amazon Virtual Private Cloud and Eucalyptus Cloud Platform.

- ii. **Public Cloud**:-The Cloud infrastructure provides resources for open use by the general public. It may be managed and operated by an academic business, or government organization, or some combination of them. Users have to pay monthly bill according to their utilizing of services. It exists on the premises of the Cloud provider. Examples of public cloud are Amazon Elastic Cloud Compute , Google App Engine and Blue Cloud by IBM.
- iii. **Hybrid Cloud**:- The Cloud infrastructure is the combination of two Cloud infrastructures (private public) that remain unique entities. IT organizations use hybrid clouds to employ cloud bursting for scaling across clouds. Cloud bursting is an application deployment model in which an application runs in a private cloud or data centre and "bursts" to a public cloud when the demand for computing capacity increases [2].

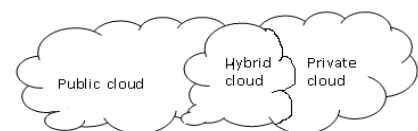


FIG 1. HYBRID CLOUD

- iv. **Community Cloud**:-In this the infrastructure is shared between several organizations from a specific community having common concerns such as security etc., whether managed internally or by a third-party and hosted internally or externally.

Using Cloud Computing the user need not buy a powerful system he just needs to connect to the internet through his net book or tablet pc and can use the computation power and memory of the Cloud. Websites like picasaweb.google.com

provide users space to store their photographs and view them globally from any part of the world. There are a number of different websites providing such services.

In Cloud Computing, three fundamental models known as services models are used for the provision of services[2].

### **Services Models**

- I. **IaaS** – Infrastructure as a service providers provide provides on-demand infrastructure services like hardware, software and storage called rentable resources to the customers. The customers request for resources which they require and pay bill per usage of resources.
- II. **PaaS** – Platform as a service model provides a complete platform include operating system, database and web server. Application developer develop, test or host their applications on cloud platform..
- III. **SaaS** – Software as a service provider install the application software in the cloud and user can use these software by paying the Cloud hosts as per his usage and needs not to install the software on his system.

### **MOBILE CLOUD COMPUTING**

The idea of Mobile Cloud Computing came forward with the rise of Cloud Computing. Mobile Cloud Computing is the combination of Mobile Computing, Mobile Internet and Cloud Computing. By using this technology, resources can be share and data need not be device specific that means could be stored in a central location and could be accessed from any device. The main aim of this technology is the provision of accurate, valuable and real time information to clients

The combination of mobile communication and internet is known as Mobile Internet technology. The main purpose of this technology is to check whether the clients achieve real time network resources and services or not[1].

What is the Mobile Cloud Computing exactly?

Mobile Cloud Computing based on three concepts:- Hardware, Software and Communication. Hardware include mobile devices like smartphones, laptops or PDAs. Software include the mobile applications in the mobile devices like browsers, games, antivirus softwares, Google's gmail, Maps and Navigation systems for mobile, Voice Search and so on. Communication includes infrastructure of mobile networks,

protocols and data delivery in their use. Mobile Cloud Computing is an extension to Cloud Computing.

In MCC, all the data processing, mobile-based intensive computing could happen on cloud thus reducing the resource requirement of mobile devices mobile such as capability of CPU, memory and so on[5].

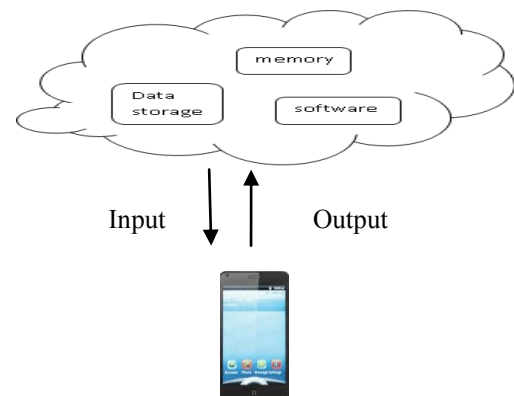
Offloading data and the execution of mobile's application in Cloud Computing is known as MCC. MCC could be a solution to the various problems find by Mobile Computing and this is done by using resources of cloud rather than the mobile devices itself to execute the mobile applications. Such a infrastructure where data and the mobile applications executions or processing could happen outside of mobile devices i.e on the cloud known as "Mobile Cloud". Many applications based on Mobile Cloud Computing, such as Maps and Navigation systems, google's gmail for mobile, Voice Search, and some applications on LiveMesh from Microsoft an Android platform, and Motoblur from Motorola, have been developed and served to users[3].

### **Challenges in MCC**

- a. Data Security
- b. Privacy
- c. Quality of communication

### **BASIC MODEL AND SYSTEM ARCHITECTURE OF MOBILE CLOUD COMPUTING**

The concept of Mobile Cloud Computing is same as of Cloud Computing but the client end of Mobile Cloud Computing are mobile devices. The clients require the services according to their need and the cloud end server provides those services to the clients [1].



**FIG. 2 BASIC MODEL OF MOBILE CLOUD COMPUTING.**

### **WORKING PROCEDURE**

The service procedure of Mobile Cloud Computing is that mobile users obtain service through user interact interface, then the needs or requirements of users are sent to the management system whose main focus is on to manage the system or data, the management system finds out the correct data resources by using configuration tools and uses suitable

system services .These services separate necessary resources from the cloud[1]. After when the application is started, then according to the situation of cloud , the monitoring and calculating function of system will follow. The system will check whether the correct resources can be distributed to the suitable clients or not by using synchronizing configuration and load balancing configuration[1].

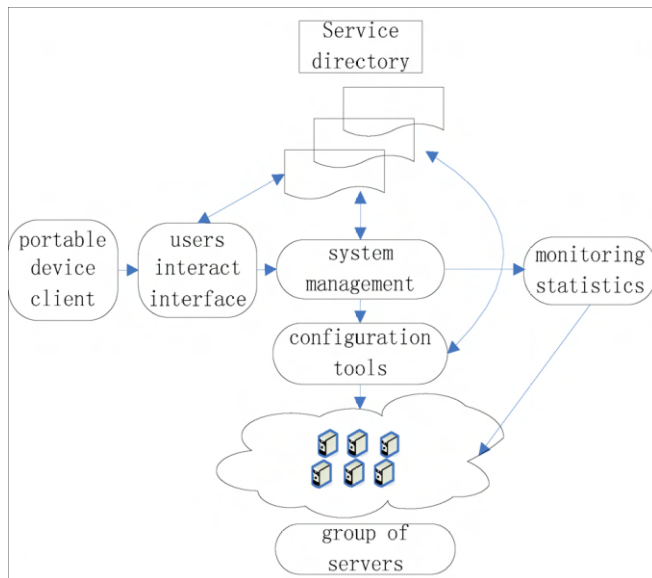


FIG 3. WORKING PROCEDURE OF MCC [1]

### OFFLOADING

Offloading[6] is the concept of sending intensive computation to resource rich servers and receiving the result from that servers(Cloud).Before actually offloading the computation, a decision is required *whether* there is need of offloading or not and if yes then *what* computation to migrate.

*Need of Offloading* : Offloading helps in overcoming the issues of limited resources of mobile systems such as battery life , network bandwidth, storage capacity and processor performance.

#### Types of Offloading:-

- Static Offloading :The decision parameters are defined at the development time .
- Dynamic Offloading : The decision is taken by considering dynamic parameters i.e at run-time of an application.

## II. RELATED WORK

Before discussing the on going work we would like to discuss some issues in Mobile Cloud Computing.

**Working issues:-** Under this category all the issues relating to the actual working i.e. Method of offloading to be used, underlying technologies such as communication channel etc.

The decision making for offloading also comes under this category.

**User level issues:-** In this various issues like presentation and usability, fault tolerance, availability requirements, supporting performance at service level portray a major concern.

**Security Issues:** - Many complications or problems occur during managing the data on the cloud. So many privacy and security questions are raised. Various issues during managing the data on the cloud comes in data access process, personal data storage on mobile cloud, data portability and interoperability. Other issues are security , privacy, reliability and effectiveness.

As Offloading is the concept for saving the mobile resources such as battery , storage ,memory and so on by migrating the computation of mobile devices to the cloud and get the result from cloud .This approach initially described by **Alexey Rudenko** et al. [8] in his paper that save power and extend battery life of an autethered laptop by doing wireless remote processing of power-costly tasks. Various experiments can be ran in this that compared the power consume by processes that run locally with the same processes that run remotely and also examine the power cost of local processing. This paper defines the technique and the results of experiments and give the suggestion to improve the given approach in future.

After that the clone cloud architecture defines by **B.-G. Chun** and **P. Maniatis** et al. [9] . The paper give idea about how the partially offloading execution can done from smart phones to a clone of smart phones on cloud ? As smart phones provide rich user experience in computing term but the resources like memory, computation and energy reserves are limited. This paper provides opportunities of execution for smart phones i.e enabled by clone cloud architecture.

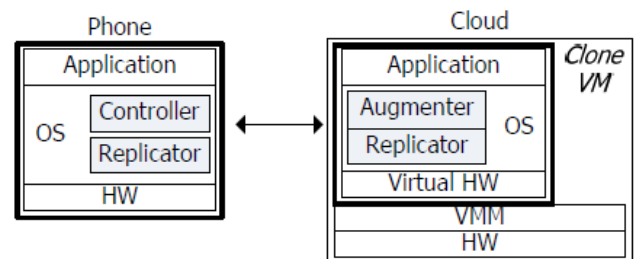


FIG. 4 Architecture of clone execution of Smartphones[9]

Fig 4 shows the architecture of clone execution for smartphones. The components of system are *operating system*, *Replicator* that synchronizing the data between phone and clone of phone. The task of migration and re-integration can be done by *Controller*. Controller migrating the computation on clone cloud and reintegrate its results back to the smartphone. Augmenter running in the clone manages the local execution and returns a result to primary. Also there are many issues comes in Offloading. . **Karthik Kumar** et al .[ 7] defines the process of computation offloading and also the various issues related to

offloading. This paper give an overview of the background ,techniques, systems, and research areas for offloading computation.

In the year 2011, **Byung-Gon Chun** et al. [10] presents the design and implementation of Clone Cloud, a system that automatically transforms mobile applications to benefit from the cloud. The system is a flexible application partition and execution runtime that enables unmodified mobile applications running in an application-level virtual machine to seamlessly off-load part of their execution from mobile devices onto device clones operating in a computational cloud. Portioning can be done by the use a combination of static analysis and dynamic profiling to partition applications automatically at a fine granularity while optimizing execution time and energy use for a target computation and communication environment. At runtime, the application can be partitioned by migrating a thread from the mobile device at a chosen point to the clone in the cloud, executing there for the remainder of the partition, and then re-integrating the results of migrated thread back to the mobile device. Clone Cloud can adapt application partitioning to different environments, and can help some applications achieve as much as a 20x execution speed-up and a 20-fold decrease of energy spent on the mobile device. In this paper an interfacing is done between the mobile and the cloud using clone cloud prototype architecture. To achieve the basic augmented execution of mobile applications on cloud that means the transfer of control from device to clone and then back means clone to device , this system overcomes the design and implementation challenges. For this system made in which the portioning, migration with merging and on-demand instantiation of partitioning are combined. This makes faster the execution of an application execute on cloud rather than execute on mobile device save the resources like battery and memory, CPU utilization.

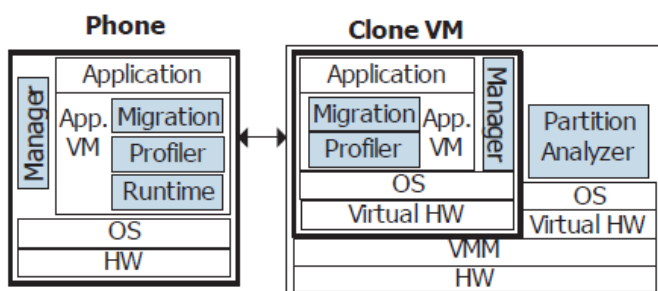


FIG. 5 Architecture of clonecloud prototype[10].

Now for Offloading, a decision must make for doing computation offloading. **Eric Chen,Satoshi Ogata** and **Keitaro Horikawa** [11] explored the design of an offloading framework that enables an Android device to offload resource intensive work to a remote server in the data center. platform and the application source code. Three decision metrics can be discussed in the paper that help framework to determine whether an operation should be offloaded given various conditions of the smartphone. The metrics proposed in this paper are only approximations. The first metric based on the total time consume for a given task. The second metric

deals with the energy consumption.[14] and the third metric deal with the remaining battery life.

In the year 2012, Mayank Arora et al. [12] The usage of smart phones has increased hastily over the last few years. The number of smart phones being sold is much more than the number of PC's due to the smart phone's mobile nature and good connectivity. However they are still constrained by limited processing power, memory and battery. This paper propose a framework for making the applications of these smart phones autonomous enough, to offload their compute intensive parts automatically from the smart phone to the virtual image of the smart phones on the cloud thus using the unlimited resources of the cloud and enhancing the performance of the smart phones. By using this framework, the application developers will be able to increase the capabilities of the smart phones making them even more feature rich. A technique to offload the applications of smart phones to cloud either it is a complete offloading of applications or partially offloading of applications was proposed. Firstly at the binary level an application is partitioned and this partitioning of application is transparent for an application developer. During the development of an application , an application developer partition the application. An application itself take the decision whether it has to be offload or not. This paper proposed a framework in which a virtual image of smart phones is made on the cloud and the application of android smart phones offload to that virtual image of smart phones on the cloud. This application used by the application

### III. CONCLUSION

Mobile cloud computing aims to empower the mobile user by providing a seamless and rich functionality, regardless of the resource limitations of mobile devices. Although still in its infancy, mobile cloud computing could become the dominant model for mobile applications in the future.

We have given an survey of current mobile cloud computing research in this paper. Highlighting the motivation for mobile cloud computing. We have also presented different definitions of mobile cloud computing in the literature. We have presented the approaches in which offloading is being used to make mobile cloud computing a success.

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