International Journal of Engineering Research and General Science Volume 5, Issue 1, January-February, 2017
ISSN 2091-2730

# Review on EMACS algorithm in Mobile Cloud Computing

Parveen kaur

Guru Nanak Dev University

Amritsar, India

pklehal@gmail.com

**Abstract**— this paper represents mobile cloud computing (MCC) which extends cloud computing with the advantages of mobility and wireless networks to create a new infrastructure where cloud takes over mobile devices' responsibilities of executing tasks and storing enormous amounts of data. The overall it shows the broad survey of mobile cloud computing and also specify concerns in mobile cloud computing which are highlighted . A taxonomy is also presented based on the key issues in this area, and discuss the different approaches taken to tackle these issues. The comparison of various techniques based on various parameters has been discussed which shows that it minimizes the response latency, cost of application migration.

**Keywords**— Cloud computing, Mobile cloud computing, Cloudlet, Load balancing, E-MACS, Energy conservation, response latency, application migration.

## INTRODUCTION

Cloud computing is described as a source of innumerous virtualized resources. These resources are in a ready state so that they can be shared at any time and can be accessed from anywhere in the world, over the Internet. An Internet based cluster system is responsible for providing services offered by a cloud. These cluster systems may be a collection of personal computers or servers. The resources provided by a cloud are organized according to a particular strategy to provide easy, fast and reliable access to services like computation, access to resources, storage, etc. Cloud computing environment requires infrastructure providers and service providers. Management of cloud platform and selection of resources according to need is done by infrastructure provider. Service provider provides resources from Infrastructure provider to end user and use different pricing models, generally it uses pay-per-use model. Cloud computing provides services to more than one user at a time using the concept of virtualization. Virtualization provides an abstraction of execution environment that can be made dynamically available to users by using some protocols, software configuration and resources.

Cloud and user are the two main entities of cloud but there are some other service level entities i.e cloud providers, cloud service brokers, cloud resellers and cloud consumers. Service providers are the companies that provide services like Internet, telecommunication services, system integration (building and supporting data centers). Cloud service broker are IT consultants, business professional service organizations, etc. that help consumer to select a cloud computing solution. They help to make a healthy relationship between consumers and providers. Cloud reseller is an important factor for extending the cloud over a region. Resellers help to expand the business of cloud providers. A reseller may be selected to resell a particular cloud based products in a region. The end users are consumers who use the cloud services.

### A. Types of clouds:

There are three types of clouds: Public, Private, and Hybrid clouds. Public cloud is a standard cloud model. This cloud makes the various IT resources available to the public. These resources are offered either for free or on pay-per-use model. Private cloud is a kind of community cloud which is available for some special users and not for ordinary people. Such clouds are build when different organizations feel same type of requirements. These clouds have high security and privacy than public clouds. The amalgamation of public and private cloud results into Hybrid cloud. It provides environment where some of the resources are personal to the organization and other are available for public use. Figure 1 shows various clouds.

### B. Mobile computing:

In the last few years a revolution has seen in computing that makes mobile computing very popular. The availability of mobile devices among the users has increased dramatically. Mobile computing is increasing repeatedly in the area of computing. An enormous growth has seen in development of mobile devices such as smartphones, GPS Navigation, PDA, embedded devices. This has changed the way humans think of computers. Mobile computing is a human computer interaction by which motivation is expected. Mobile computing is a result of combination of hardware, software, and communication.

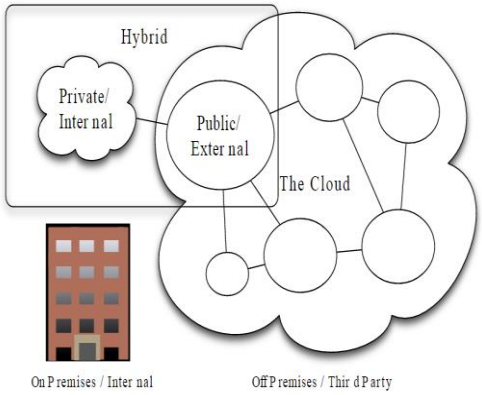


Fig 1: Cloud computing types

Mobile hardware involves all the required components needed for mobility. Mobile software deals with all the requirements of mobile applications. Communication involves infrastructure network, ad-hoc network, protocols, encryption techniques, communication properties. Mobile computing helps to use the same computing device when location properties changes frequently. Mobility and Portability are main aspects of it. Mobile computing allows users to access the services of computing without any pre-defined location or connections to network. Mobile computing provide some features such as portability, mobility, increased productivity, dis-symmetrical network communication. But mobile resources are weak resource of computing due to limited energy, size, computing power.

As the mobile devices has limited resources so this results into serious problems like Quality of service (QoS) insurance, mobility management, security issues, energy management. So these problems motivated the researchers in the area of mobile computing to find an infrastructure that can provide resources to mobile devices. So cloud computing was found helpful. In cloud computing, a cloud provider has control over the resources and services and these can be accessed over the Internet. With improved communication technologies like 3G, Wi-Fi, etc. the requirements of resource constrained mobile devices can be shifted to cloud computing system. These requirements can be processing, storage or memory requirement.

C. Mobile cloud computing:

Mobile cloud computing (MCC) is an amalgamation of cloud computing and mobile computing. Figure 2 shows th MCC environment. In moble cloud computing the tasks are offloaded to cloud and after careful scheduling, the tasks are executed on cloud and mobile devices which in turn improve the performance of mobile devices. The performance improves because the servers at the cloud side have much high computing power and speed than the mobile. The offloading of tasks also saves energy in mobile devices. Some advantages of mobile cloud computing are:

- Mobile devices give its users an easy access to cloud services from anywhere in the world.
- Mobile cloud services get the information about device location, requested services and context for better user experience.
- Every mobile has energy, computing and storage resources that are limited. Mobile cloud computing even helps in computations that require much more resources than available.

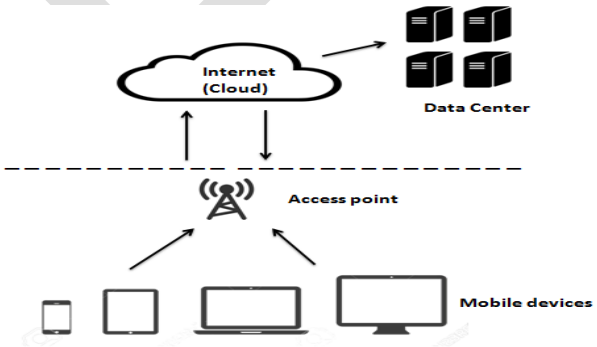


Fig 2: Mobile cloud computing

So mobile cloud computing is and infrastructure where data storage and computing happens outside the mobile device and after computing the results are returned to the mobile device. This storage and computing is done on a centralized computing platform located at cloud side. The applications are accessed over the Internet through a web browser on mobile devices. Mobile cloud computing not only provides cloud's resources to mobile but also inherits its features like scalability, low cost, robustness. According to an experiment constructed in [1], the application is first divided into tasks and these tasks are then offloaded to the cloud. So in MCC, the application as a whole or its parts can be offloaded to the cloud. This helps to handle the sophisticated applications and services like mobile games, voice searching, mobile sensing. In order to make MCC efficient, researchers have proposed different

architectures. There are mainly four categories of architectures. In first category, the mobile applications are offloaded to large remote data centers on cloud and after computations results are returned to the mobile devices. But this type of architecture introduces a problem of response latency. In second category, the mobile applications are offloaded to the local service infrastructures known as cloudlets which are logically implemented at access points of mobile devices. In third category, the mobile devices collaborate with each other to make a pool of resources and applications run on this collaboration. This collaboration is known as local mobile cloud. It eliminates the need of any remote cloud infrastructure. In fourth category, the cloud infrastructure is moved close to the user to improve response time. Different architecture for MCC proposed by researchers are Cloudlet, Cloudsim, Hyrax, CloneCloud, MAUI. These architectures utilize cloud resources as well idle mobile resources in order to provide computing results with higher QoS. But offloading applications to cloud introduce a problem of response latency. Meanwhile, various mobile cloud computing based application have been developed like Google Maps, Gmail, Navigation system, MobileMe, MotoBlur, Live Mesh, etc. According to a research, the MCC based applications and softwares have increased to approximately 88% in last few years. This large number of applications has contributed billions of dollars to the IT business.

The meeting of mobile computing and cloud computing arises a new architectural element known as Cloudlet. At the University of Rochester, a new architecture has been developed known as Mobile Cloud Hybrid Architecture (MOCHA) which introduced the cloudlet. It is the second tier of three tier hierarchy of mobile cloud computing- mobile devices, cloudlet and cloud. Cloudlet helps to bring the cloud closer to the users. A cloudlet is the ideal offload site for cognitive assistance as it is a powerful, well-connected and trustworthy cloud proxy that is just one wireless hop away. In mobile-cloudlet connection, the user's mobile search and connects with the nearby cloudlet. Then all the applications are offloaded to the cloudlet. It may further search for the cloud for some services and when all the processing is done, results are returned to mobile. In recent years, growing investments in cloudlet like infrastructure have been seen like Nokia announced RACS (Radio Access Cloud Platform) availability to its user in 4G cellular system, Dell, Huawei have also introduced micro data centers.

**E-MACS ALGORITHM IN MCC:**

Energy-aware Mobile Application Consolidation and Scheduling. A new scheduling algorithm is proposed in [2]. This algorithm helps to minimize the makespan of tasks and resources required. To achieve good QoS, the load balancing and reduction in energy consumption should be done efficiently. The concept of application consolidation is used in this method. The idle applications are migrated to a server and then that server is shut down. The idle applications are considered to be consuming more applications than the running applications. Application consolidation makes better utilization of servers. The main objective of this algorithm is to keep the load balanced by efficient scheduling of applications so as to achieve QoS. This algorithm helps in better resource utilization, reduce the end-to-end latency and reduce energy consumption. The working mechanism of EMACS is as:

1. Requests are submitted by mobile devices.
2. Offload the applications to cloudlet using Internet.
3. Applications are executed by cloudlet. Idle applications are moved to a server which is then temporarily shut down.
4. The E-MACS algorithm is then executed for application scheduling.
5. While scheduling the applications are offloaded to mobile devices in a local mobile cloud.
6. Various mobile devices are available that acts as resource provider and they have different loads.
7. Offload applications to mobile devices with least load.
8. Return results to cloudlet.
9. Cloudlet further return results to the mobile devices.

The working mechanism of E-MACS is represented in figure 3.

**RELATED WORK:**

Wei et al. [1] introduced a new model called HLMCM by modifying the cloudlet architecture. HLMCM has low response latency but scheduling becomes a problem. So HACAS algorithm is proposed to solve this problem. The load balancing scheme of this algorithm is 60% efficient than normal scheme. Shakkeera et al. [2] focused on energy conservation and purposed a new EMACS algorithm to minimize energy consumption in cloudlets. EMACS make the use of local mobile cloud and has efficient task scheduling criteria. The makespan of EMACS is 70% better than the HACAS and ACO. It also improves average latency, load balancing and resource utilization. Fernando et al. [3] considered various problems and suggested solutions to tackle them. An architecture is also purposed for mobile computing to improve privacy, security and cost factors. The architecture has three main components: Resource handler, Cost manager and Job handler. It helps to manage resources, minimize cost and handle jobs easily. Wua et al. [4] introduced a new algorithm for scheduling. This algorithm sort all the tasks according to their priority and then calculate their completion time with respect to different services. Then it executes the best suited service. This algorithm focuses to improve QoS factor. Lin et al. [5] proposed a new algorithm to minimizing the energy consumption by mapping the tasks to local cores or by migrating them to cloud. The experimental results show that the energy consumption reduces with a factor of 3.1. It also satisfies the completion time constraint. Mishra and Jaiswal [6] introduced a new method based on Ant Colony Optimization to improve load balancing. In this method, every node has a pheromone table which stored probability values for all possible destination nodes. Ants refer these probabilities to move to next node and also update its probability values corresponding to their source node. This method helps to separate load among many possible paths in network. Yamauchi et al. [7] introduced a new methodology for Distributed Parallel

Scheduling in mobile cloud computing. In the proposed methodology, a master device monitors some parameters of slave devices and if these parameters come out to be inadequate for performing parallel programming then master device selects other slave devices. This method improves load balancing and considers battery consumption, network quality which in result improves the overall performance of mobile device. Karthik et al. [8] considered some of the problems of mobile computing and discussed Computation Offloading as a solution to it. In computation offloading, the heavy computations are offloaded to the external resource providers and results are returned back to mobile devices. Future work of different research areas in offloading is also highlighted. Jaiswal et al. [9] described performance analysis of different cloudlet architectures. The conclusion of this comparison is that VM based cloudlet architecture is more efficient than other architectures. Suryadevera et al. [10] purposed a new algorithm based on ACO for load balancing. This algorithm calculates pheromone value by considering various parameters. Higher pheromone trail represents shortest path. The pheromone represents the capability of resources to do various computations. The purposed algorithm improved the throughput of the system and helped to improve the overall system performance in grid computing. wang et al. [11] presented a survey of mobile cloud computing applications of existing and future generation. The challenges faced while building mobile cloud computing applications are discussed. A survey of existing solutions to these problems is provided and suggested a future search direction of combining trust management techniques to introduce a new method which can enhance QoS and security of mobile cloud computing. Yang et al. [12] purposed a novel offloading service that helps to offload heavy tasks from mobile handsets to nearby extrinsic resource rich surrogates. The purposed service can efficiently offload the applications if they are implemented in java. The experimental results prove the effectiveness of the service.

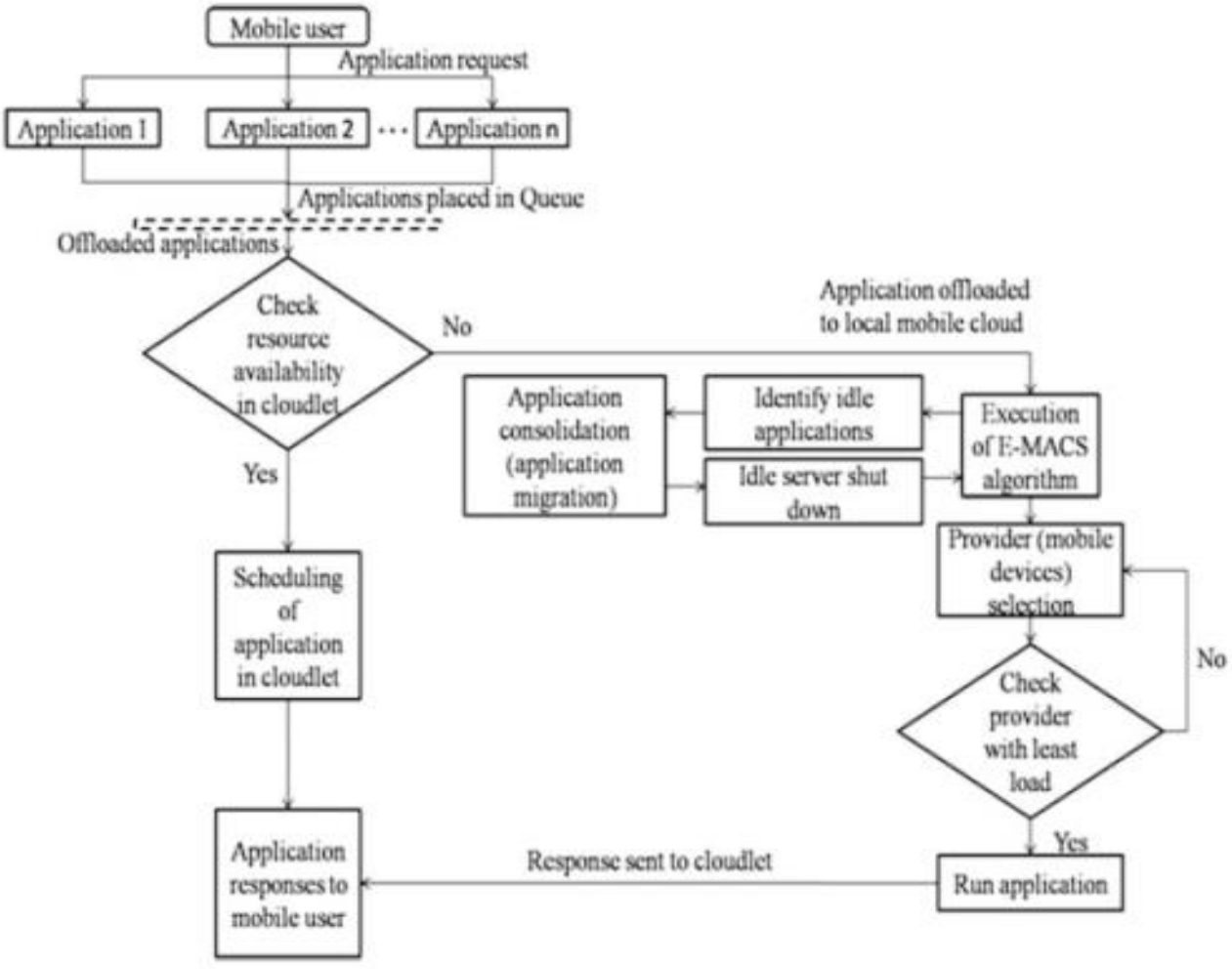


Fig 3: Workflow of E-MACS

**COMPARISON TABLE:**

| Refrence | Title | Objective | Resource management | Response latency | Energy consumption | Load balancing | Less Cost |
|---|---|---|---|---|---|---|---|
| [1] | Application Scheduling in Mobile Cloud Computing with Load Balancing | To improve computing and sensing capabilities of mobile devices using HLMCM | ✓ | Low | Less | ✓ | |
| [2] | Energy-Aware Application Scheduling and Consolidation in Mobile Cloud Computing with Load Balancing | To minimize the energy consumption | ✓ | Low | Less | ✓ | |
| [3] | Mobile cloud computing: A survey | To exploit the locally available mobile resources | ✓ | Low | | ✓ | ✓ |
| [5] | Energy and Performance-Aware Task Scheduling in a Mobile Cloud Computing Environment | To minimize energy consumption by migrating tasks among the local cores and the cloud. | ✓ | Low | Less | ✓ | |
| [6] | Ant colony Optimization: A Solution of Load balancing in Cloud | A method is purposed based on ACO to minimize load balancing | ✓ | Low | | ✓ | |
| [7] | Effective Distributed Parallel Scheduling Methodology for Mobile Cloud computing | To improve the values of some parameters in MC using new distributed parallel scheduling methodology for MC. | | Low | Less | | ✓ |
| [8] | A Survey of Computation Offloading for Mobile Systems | Provide detailed knowledge about computation offloading | | Low | Less | ✓ | |
| [10] | Cloudlets: at the Leading Edge of Mobile-Cloud Convergence | To show how cloudlets enable cognitive assistant applications. | ✓ | Low | | | |

## CONCLUSION

Regardless of increased usage of mobile computing, utilizing it to its fullest potential is very difficult due to its intrinsic problems such as limited resources, mobility and repeated disconnections. Mobile cloud computing can tackle with these problems by migrating mobile applications on external resource providers. In this paper represents the various types of clouds and among one of these mobile cloud computing is discussed with EMACS algorithm and also compare the different techniques based on the various parameters which shows that it minimizes the response latency, cost of application migration. But still there are some issues with E-MACS have shown a low convergence rate to the true global minimum even at high numbers of dimensions. So to overcome these issues we will propose a new hybrid backtracking search optimization algorithm and EMACS for cloud computing environment.

## REFERENCES:

[1] Wei, X., Fan, J., Lu, Z., Ding, K.: Application scheduling in mobile cloud computing with load balancing. Hindawi Publishing J. Appl. Math. (2013)
[2] Shakkeera, L., Tamilselvan, L.: Energy-Aware Application Scheduling and Consolidation in Mobile Cloud Computing with Load Balancing. Springer Communication and Applications, DOI 10.1007/978-81-322-2553-9_25 (2016).
[3] Fernando, N., Loke, S.W., Rahayu, W.: Mobile cloud computing: a survey. Elsevier Trans. Future Gener. Comput. Syst. 29(1), 84–106 (2013)
[4] Wua, X., Denga, M., Zhanga, R., Zengb, B., Zhoua, S.: A task scheduling algorithm based on QoS-driven in cloud computing. Elsevier First Int. Conf. Inf. Technol. Quant. Manag. 17, 1162–1169 (2013)
[5] Lin, X., Wang, Y., Xie, Q., Pedram, M.: Energy and performance-aware task scheduling in a mobile cloud computing environment. In: IEEE International Conference on Cloud Computing (2014)
[6] Mishra, R., Jaiswal, A.: Ant colony optimization: a solution of load balancing in cloud. Int. J. Web Semant. Technol. 3(2) (2012)
[7] Yamauchi, H., Kurihara, K., Otomo, T., Teranishi, Y., Suzuki, T., Yamashita, K.: Effective distributed parallel scheduling methodology for mobile cloud computing. In: SASIMI 2012, the 17th Workshop on Synthesis and System Integration of Mixed Information Technologies, pp. 516–521 (2012)
[8] Kumar, K., Liu, J., Hsiang, Y.: A Survey of Computation Offloading for Mobile Systems. Springer Science+Business Media, LLC 2012
[9] Jaiswal, A.S., Thakare, V.M., Sherekar, S.S.: Performance based Analysis of Cloudlet Architectures in Mobile Cloud Computing. International Journal of Computer Applications (0975 – 8887). National Conference on Recent Trends in Information Security (NCRTIS-2015)
[10] Satyanarayanan, M., Chen, Z., Ha, K., Hu, W., Richter, W., Pillai, P.: Cloudlets: at the Leading Edge of Mobile-Cloud Convergence. IEEE 6th International Conference on Mobile Computing, Applications and Services (MobiCASE) (2014).
[11] Wang, Y., Chen, I.-R, Wang, D.-C.: A survey of mobile cloud computing applications: perspectives and challenges. Wireless Pers. Commun. (2014)
[12] Yang, K., Ou, S., Chen, H.-H.: On effective offloading services for resource-constrained mobile devices running heavier mobile internet applications. Mobile Internet Technol. Appl. (2008)
[13] Dinh, H.T., Lee, C., Niyato, D., Wang, P.: A survey of mobile cloud computing: architecture, applications, and approaches. Wireless Commun. Mobile Comput. 13(18), 1587–1611 (2013)