RESEARCH ARTICLE OPEN ACCESS

The Design of an Intermediate Cooperator for Resource Cooperation in MCC

Er. Manpreet Kaur [1], Er. Manoj Agnihotri [2]
Research Scholar [1], Assistant Professor [2]
Amritsar College of Engineering & Technology
Amritsar - India

ABSTRACT

Mobile cloud computing is a paradigm for supporting the quality of mobile services. In this paper, we observe the resource sharing problem to support mobile applications in a geo-distributed mobile cloud computing environment. The resources are such as radio and computing resources. Mobile cloud service providers can cooperate to share their own resources with each other, in this environment. As a result, the resources can be better utilized and fulfill user's requirements. To increase the advantage of the mobile cloud service providers, we propose a framework for resource cooperation to the mobile applications among service providers. For resource cooperation to the mobile applications, we introduce an inter-mediator cooperator model to obtain better efficiency, to decrease cost and to minimize the distance and delays while meeting the resource requirements of the mobile applications. Based on the certain parameters using inter-mediator cooperator, the mobile cloud service providers can decide whether to cooperate and share the resources in the local resource pool or remote resource pool based on the resource requirement.

Keywords:- Cloud Computing, Mobile Cloud Computing, Resource Management, Resource Allocation, Resource Cooperation in GMCC Environment.

I. INTRODUCTION

A) Cloud Computing:- It is a Phenomenon that represents the way by which IT services and functionality are charged for and delivered.

According to NIST (National Institute of Standards and Technology, USA.) "Cloud Computing is a model for enabling convenient on demand network access to a shared pool of configurable resources(Example networks, Servers, Applications, Storage and services) that can rapidly be provisioned and released with minimal management effort or service provider interaction."

According to Seanand Martson, "It is an information technology service model where computing services are delivered on demand to customers over a network in self service fashion, independent of device and location. The resources required to provide the requisite quality of service levels are shared, dynamically scalable, rapidly provisioned, virtualized and released with minimal service provider interaction. Users pay for the service as an operating expense without incurring any significant initial capital expenditure with the cloud services employing a mattering system that divides the computing resource in appropriate blocks"

Fig 1: Cloud Computing

B) MOBILE CLOUD COMPUTING

The "mobile cloud computing" was launched in mid-2007 and introduced not long after the concept of "cloud computing. Mobile Cloud Computing is the combination of Cloud computing, Mobile Computing and Wireless Networks. It provides new type of facilities and services for mobile users so that they can take the advantages of cloud computing.

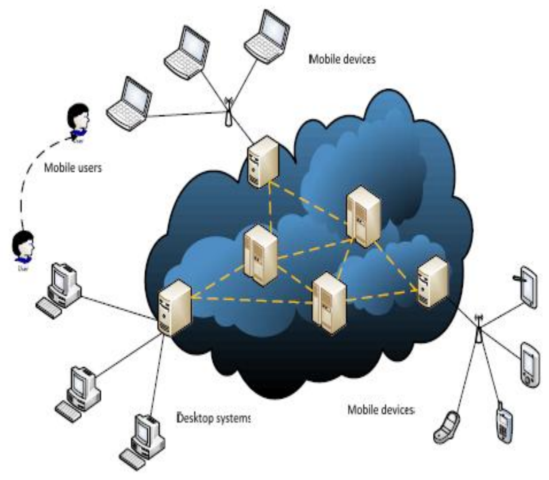

Fig 2: Mobile Cloud Computing

"Mobile Cloud Computing is defined as an infrastructure in which the data storage, the data processing and computations are performed outside of the mobile device. Mobile cloud applications move the computing power and data storage away from mobile phones and store into the cloud, bringing mobile computing and applications to not just Smartphone users but much broader range of mobile users or subscribers".

C) GEO-DISTRIBUTED MOBILE CLOUD COMPUTING (GMCC): GMCC is a rising paradigm that includes geo-graphic consideration in Data centers are spaced in each region.

- Data centers are predominantly accountable for local applications or requisitions from mobile devices such as mobile phones and vehicles. It includes both radio resources and computing resources.
- It is responsible for providing the computing resource to the application server. In cloud, running applications consume resources from the application server.
- Service provider is responsible for managing the cloud resources as a manager. To run the applications, it will allocate resource by virtual machine (VM) to each user.

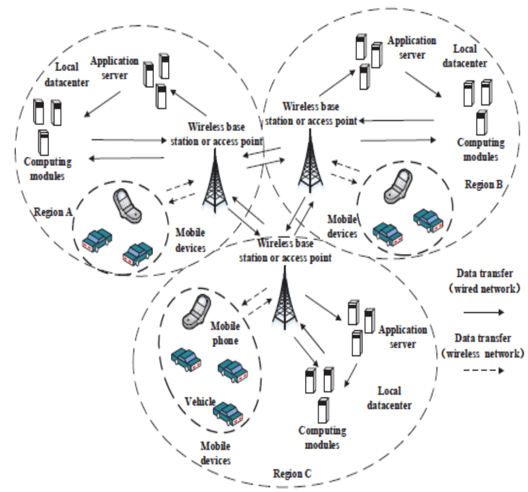

Fig 3: The Geo-Distributed Mobile Cloud Computing Environment

D) RESOURCE MANAGEMENT IN MOBILE CLOUDS

Mobile cloud computing can be defined as sharing of computing resources within a mobile ecosystem. The mobile resources are not enough and their availability is unpredictable. For combining mobile devices into cloud computing big efforts are made permitting the former access to enormous resources of the end. Cloud storage is available, from an intermediate tier or using processing power in the data center, for mobile needs is at its early stages [7].

Resource management techniques like resource reservation are a key approach to maintain the quality of service (QoS) Performance. This is significant with real time requirements for mobile cloud Computing applications. To maximize the Utilization of the resources and thereby maximize the revenues of the mobile cloud service providers, Efficient Resource management methods are involved. To handle this resource management problem and also to enhance the revenue of mobile cloud service providers, a resource pool can be generated. Specifically, multiple cooperative mobile cloud service providers can share their resources (e.g. radio and computing resources) in the pool. As a result, the resources which are not used by one service provider can be used by other service providers, when required, and thereby, the resource Utilization can be increased [8].

E) RESOURCE ALLOCATION

Resource allocation is the process of distributing available resources between the various applications running in a cloud environment. There are several problems addressed by an optimal resource allocation:

- Resource contention
- Scarcity of resources
- Resource fragmentation
- Over-provisioning
- under-provisioning

There are different type of resources such as data-center resources i.e. available servers, storage space and network bandwidth and computing resources directly available to mobile devices.

At data-center level for resource allocation and optimization there are multiple tiers: at cluster or supercomputer, virtual machine and operation system disk image levels.

Different objectives can be followed for any of those levels: growing power usage efficiency, enhancing performance, expanding or protecting a predefined level of advisability for provided services, lowering the data-center air conditioning costs or a combination of them.[7]

Resource allocation is of two types:

1. **Local Resource allocation**: This type of application is best for applications which have a high latency requirement service and small travelling radius. Users can benefit from the local service even when they move to other region.

2. **Remote Resource Allocation** needs high bandwidth for data transmission. When application requests over reached its ability or users approach to leaving then remote resource allocation can be implemented. VM migration joins the two types of resource allocation by migrating service to the region it moves toward. Resource cooperation has a tendency to control the severe unbalance of SPs resource utilization [1].

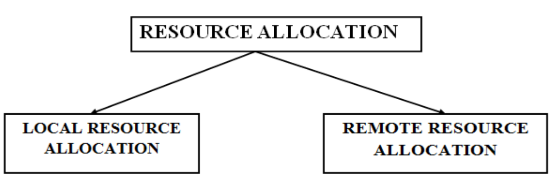

Fig 4: Types of Resource Allocation

F) RESOURCE COOPERATION

Sharing of resources within same or different data centers is known as resource cooperation. To increase the available resource for mobile applications, multiple providers can cooperate and create a resource pool. There are two types of resource cooperation

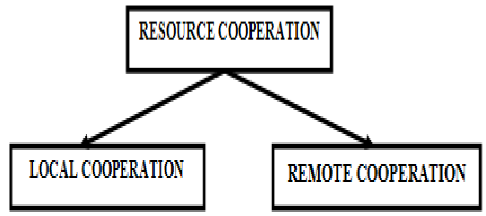

Fig 5: Types of Resource Cooperation

1) In the **Local Cooperation**, the resource sharing is between different SPs in the same data center. The local cooperation is based on the agreement of sharing both physical resource and bandwidth resource. If SPs on a high security conditions, it will not take the risk of information leakage by running applications on other SPs.
2) In **Remote Cooperation,** the resource sharing happens between different data centers. It consider trip of mobile devices, communication cost and resource utilization.

Resource cooperation in GMCC Network

- Service Providers have resource in different data centers and provide different services in GMCC network.
- Consider the following scenario:

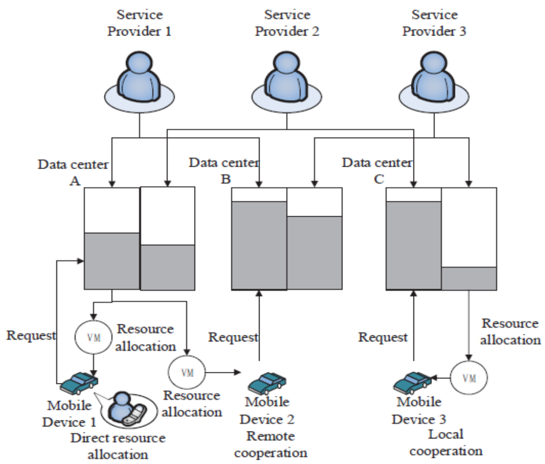

Fig 6: Resource Sharing and Cooperation

- Consider three data centers named as A, B and C that are located in different regions.
- SP_1 hire resource from data center A and B. SP_2 rents resource from data center A and C.SP_3 rents resource from data center B and C.
- Actually in the same data center, there are many SPs that rent out the resources. Moreover each SP can rent out resources from more than two data centers. It is observed that same SPs in different data centers may have different coefficient of resource utilization. As in above fig SP_1 has higher coefficient in data center B than in data center A. It is also observed that the coefficient of resource utilization is also different in same data center among different SPs. As in above fig SP_2 has higher coefficient in data center C than SP_3.
- The application request from Mobile Device1 (MD_1) can be directly allocated with VM on local SP_1.
- In case of non-cooperation, SPs will directly allocate the resource to user when it has sufficient resources.
- There are two kind of resource sharing i.e. Remote cooperation and Local cooperation. In remote cooperation, the resource sharing happens between different data centers. As in above scenario, MD_2 sends application request to local operator SP_1 in data center B. If SP_1 has few resources then it may ask to remote cooperator for sharing the resources. .

  In local cooperation, the resource sharing happens between different SPs in same data center. As, SP_3 receives application request from MD_3 and ask SP_2 for cooperation.

II. RELATED WORK

In GMCC, users are allowed to access cloud services such as computation and storage resource that are adjacent to mobile devices according to geographical area. In GMCC, it requires to satisfy latency and resource demands to run mobile applications. Therefore Management strategy of cloud computing resource will become more cost coherent and resource coherent by considering geographic information and user's behavior. GMCC is favorable for vehicle network with high mobility where vehicles have position details at anytime. Cost coherent scheme is very significant in case of fast moving vehicles. It includes navigation service, location based service and accident alert. It makes resource allocations more complex and critical. To minimize the transmission power of mobile devices, they proposed a computation resource and joint radio optimization scheme [1].

The study [2] presented, in order to improve service quality and reduce service delay in mobile clouds; a new strategy had been presented named as server selection strategy. Centralized infrastructure of Mobile Cloud Computing has several drawbacks such as: long distance to users, limited resource sharing, high bandwidth for communication.

[3] Presented a Mobicloud system that is a geo-distributed mobile cloud computing resource furnishing platform and is able to provide resources like storage, computing and networking that significantly increases the ability of mobile devices. They integrate Xen virtualization, network based storage and OpenFlow network based management solutions into single smart system. The authors in [4] proposed algorithms to check the replication of content across data centers and a request distribution algorithm cognizant of content locations within geo-distributed clouds. Qian and Rabinovich [5] solved the integrated problem of provisioning application instances in a geo-distributed cloud and distributing using routing policies. To process End User requests to these instances; they proposed a novel demand

clustering approach which scales to realistic system. Researchers [6] had considered workload management in the context of geo distributed clouds, i.e. cloud resources in mobile cloud environments are easily accessed by users that are geographically distributed in data centers, but that are managed by a single organization.

The authors in [9] discussed Resource management for cloud environment. They outlined a framework for cloud resource management by classified the field into eight sub domains related to global scheduling, local scheduling, pricing, application scaling, demand profiling, workload management, cloud management, utilization estimation and measurement studies. For Resource allocation an optimization models such as linear programming, robust optimization etc to the mobile applications and core and Shapley value from cooperative game for revenue management and Nash Equilibrium solutions for cooperation formation among service providers were discussed in[10]. They [11] considered resource allocation algorithms for distributed cloud systems, which deploy cloud-computing resources that are geographically distributed over a large number of locations in a wide-area network. They developed efficient resource allocation algorithms for use in distributed clouds and an efficient 2-approximation algorithm for the optimal selection of data centers in the distributed cloud. Their objective was to minimize the maximum distance, or latency, between the selected data centers. Finally, they developed a heuristic for partitioning the requested resources for the task amongst the chosen data centers and racks.

[12]They introduced a model for wireless interfaces, mobile application profiles, and cloud resources that saves the mobile battery life and guarantees both cost and QoS. The proposed model was depends on the WNC i.e. wireless network cloud concept. Then, assuming application quality of service (QoS) profiles, power consumption and corresponding cost functions, a multi-objective optimization approach using an event-based finite state model and dynamic constraint programming method had been used to determine the proper process power, transmission power, optimum QoS profiles and cloud offloading. [13] Proposed a game-theoretic approach to optimize the energy consumption of the MCC systems. The cloud servers and mobile devices energy minimization problem as a congestion game was introduced. Prove that the Nash equilibrium always exists in this congestion game, and proposed algorithm achieved Nash equilibrium in polynomial time. This approach minimizes the total energy compare to a random approach and tries to reduce mobile devices energy. Mobicloud [14] is a cloud computing technology proposed for mobile ad hoc networks. In this architecture each mobile node is supposed as a service node that can be used as a service broker or service provider based on its communication and computation abilities. Cooperative caching can be effectively used in type of networks where the applications like mobile ad hoc networks are focused on users having indistinguishable interest.

[15] Discussed the game theory approach, coalition of the cloud service providers where the uncertainty of internal users from each provider considered. First, to study the resource and revenue sharing for cloud providers with respect to randomness of demand, a stochastic linear programming game model was developed. Then, to model coalitional arrangement Markov chain used, for forming the cooperation to share resource and revenue the coalitional game was determined. The authors in [16] recommended a cooperative, mobile resource sharing method that taking into account both the inherent properties and the number of mobile devices in mobile cloud environments. The proposed method was composed of four main components: mobile resource monitor, job handler, resource handler, and results consolidator. [17] Presented a cooperative caching framework for a cloudlet based mobile cloud computing architecture. The main purpose of cloudlet is to minimize the distance between cloud services and mobile devices because when the distance is increased the end to end user delay is also increased, which may not be feasible for some applications.

[18] Considered the concept of how to maximize the lifetime of a highly collaborative mobile device cloud. They achieved this by introducing techniques for controlling the accessible power across devices under different connectivity assumptions. They

introduced an experimentation platform to obtain computation profiles and realistic power. They discussed that effective management of resources across the nodes in such a Mobile Device Cloud (MDC) can significantly improve their utility as powerful computing platforms.[19] Discussed that transmission rates significantly improve, if mobile devices cooperate to utilize their comprehensive processing power. Thus, for this situation, i.e. to effectively utilize energy and processing power they developed an *energy-aware cooperative computation* framework. This framework contributes a group of algorithms including flow, cooperation and scheduling as well as computation and energy controls.

III. PROBLEM FORMULATION

The main focus of previous work was on geo distribution without considering the type of resource cooperation i.e. local or remote .Choosing one which is suitable or best according to user or client requirement.

In the local cooperation, the resource sharing is between different SPs in the same data center. So, if local cooperation is considered then distance will be less and time taken by SP to allocate resources will also be less. The local cooperation is based on the agreement of sharing both physical resource and bandwidth resource. If SPs on a high security conditions, it will not take the risk of information leakage by running applications on other SPs.

In remote cooperation, the resource sharing happens between different data centers. It consider trip of mobile devices, communication cost and resource utilization. As the distance between different data centers is greater than in local it increases the cost and also increases communication delays and reduces the transmission rate. In remote cooperation the availability of resources is more efficient than in local.

The results demonstrated that short distance to data centers result in small bandwidth consumption, short startup delay and satisfactory service quality.

IV. PROPOSED SYSTEM

In the proposed system**,** remote data center directly rent out every time. For this, we propose a Virtual Machine which behaves like a resource cooperator between same data center and remote data center.

If the requirement of application exceeds in the case of local cooperation, then the intermediate cooperator (IC) will start finding the proper remote data center on less cost and at efficient transmission. If it finds another data center with low cost and high configuration then it will automatically switch to another remote cooperation without any downtime. After receiving application request from the user system will refresh the network parameters i.e. cost, utilization coefficient, weight of each edge.

The Intermediate cooperator will calculate the revenue cost and get the utility of non cooperation, remote cooperation and local cooperation. Intermediate cooperate will also find the best factor for application utility & after comparing both systems, the system having less cost & high efficiency will provide to application request.

Intermediate cooperator will also check genuine request. For this, request checker will be there.

V. PROPOSED METHODOLOGY

Step 1: First of all initialize cloud network with various machines and tasks.

Step 2: Start the task queue for allocation task to resources

Step 3: Check the available resources.

Step 4: If require cooperation, High alert resource activates Then initiate Intermediate cooperator(IC).

Step 5: Then it will find available resources on different SPs (Service Providers).

Step 6: If accurate task found pass task to resource

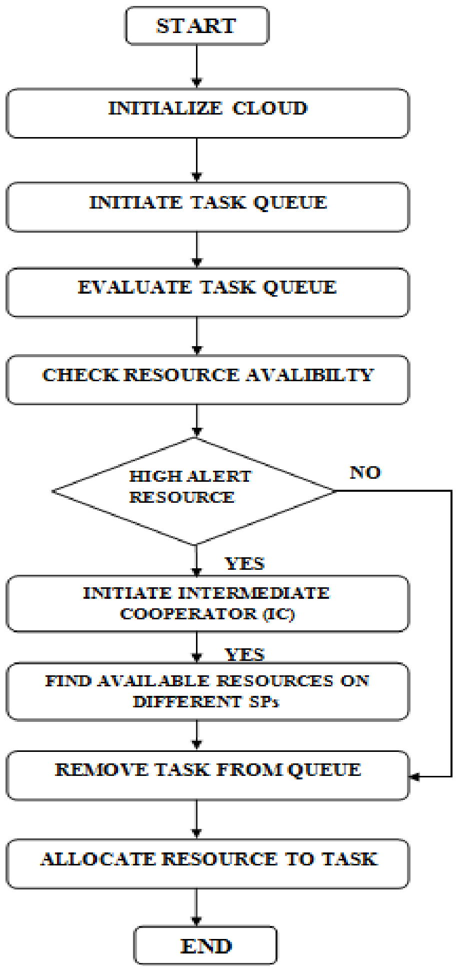

Fig 7: Flowchart of the proposed technique

Step 7: If no cooperation is required then simply remove task from queue and allocate task to resource.

Working of IC

1. In general, an IC is someone who acts as an intermediary between two or more parties during cooperation and sharing.
2. The IC's role may simply be to save the user time by researching services from different SPs and providing the user with information. In this framework, the IC works with the user to understand provisioning needs, work processes, budgeting and data management requirements. The IC presents the customer with a short list of recommended service providers, after the research has been completed and the customer contacts the SP of choice to arrange service.

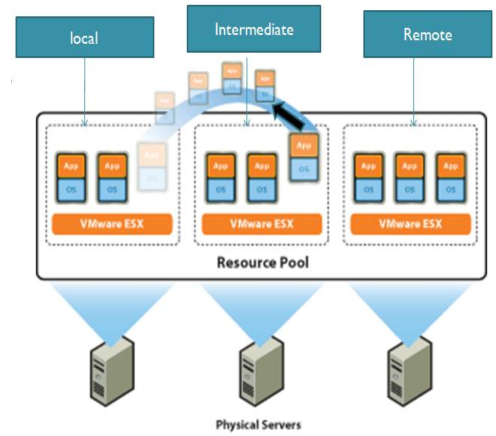

Fig 8: Proposed Architecture

3. An IC may also be permitted the rights to cooperate or share with service providers on behalf of the user. In this framework, the IC is given the power to distribute services across multiple SPs in an effort to be as cost-coherent as possible, in case of any complexity multiple SPs might involve.

4. In addition to acting as an intermediary, an IC might also provide the user with additional services, such as encryption, reduplication and transfer of the customer's data to the cloud and assisting with data lifecycle management (DLM).

5. An IC is a software application that facilitates the distribution of work between different cloud service providers.

VI. EXPERIMENTAL SETUP

The experimental module and results are conducted on Cloudsim simulator. Cloudsim is an extensible simulation framework that enables seamless simulation, modelling, and experimentation of emerging Cloud computing infrastructures and management services. It supports modelling and instantiation of large scale Cloud computing infrastructure, including data centers on a single physical computing node and java virtual machine.

Below shows the basic model for execution of scheduling algorithm using Cloudsim.

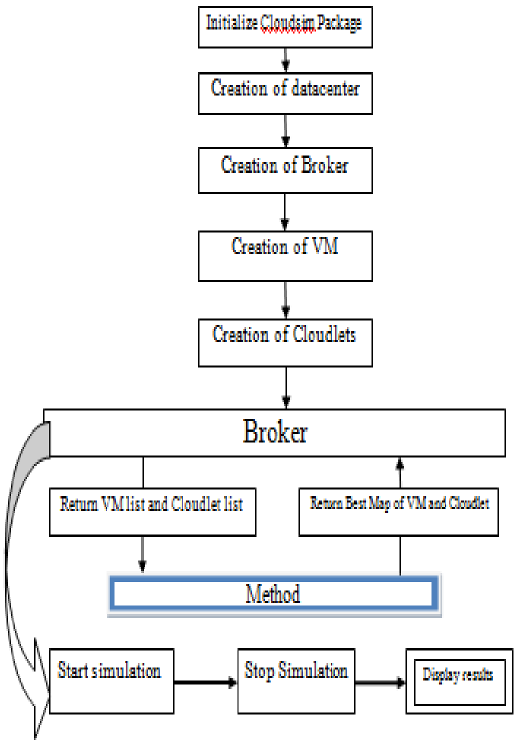

Fig 9: Basic working concept

VII. CONCLUSION

The motivation behind the proposed approach (i.e. An Intermediate Cooperator) is quite simple and effective. The use of Intermediate Cooperator will allow cooperating or sharing the services and resources more efficiently, with minimum delays and high transmission rate. In this paper, the proposed technique that is IC shows better results than the simple cooperation.

REFERNCES

[1] Rong Yu, Jiefei Ding, Sabita Maharjan "Decentralized and Optimal Resource Cooperation in Geo-distributed Mobile Cloud Computing" 2168-6750, IEEE Transactions, 2015.

[2] R. Liu, X. Yuan, J. Xu, Y. Zeng, M. Cao, J. Liu, L. Xu, Q. Fang, *et al.*, "A novel server selection approach for mobile cloud streaming service,"*Simulation Modelling Practice and Theory*, vol. 50, pp. 72–82, 2015.

[3] Tianyi Xing, Dijiang Huang et.al "MobiCloud: A Geo-distributed Mobile Cloud Computing Platform", 978-3-901882-48-7, 2012.

[4] Wu, Y., Wu, C., Li, B., Zhang, L., Li, Z., Lau, F.: Scaling social media appli- cations into geo-distributed clouds. In: Proc. 2012 IEEE International Conference on Computer Communications (Infocom 2012), pp. 684{692. IEEE (2012). DOI 10.1109/INFCOM.2012.619581

[5] Qian, H., Rabinovich, M.: Application placement and demand distribution in a global elastic cloud: A unified approach. pp. 1{12. USENIX (2013)

[6] Brendan Jennings and Rolf Stadler "Resource Management in Clouds: Survey and Research Challenges, Workload Management in Geo-distributed Clouds" Journal of Network and System Management, 2013

[7] Andrei IONESCU "Resource Management in Mobile Cloud Computing" *Informatica Economică* vol. 19, no. 1/2015

[8] 1D.NAVEEN, 2V KAVITHA "Effective Resource Management In Mobile Cloud Computing" VOL NO:2, ISSUE-4, 2015.

[9] Brendan Jennings and Rolf Stadler "Resource Management in Clouds: Survey and Research Challenges" Journal of Network and System Management, 2013.

[10] Rakpong Kaewpuang, Dusit Niyato, Ping Wang, "A Framework for Cooperative Resource Management in Mobile Cloud Computing" IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS, VOL. 31, NO. 12, DECEMBER 2013 2685.

[11] Mansoor Alicherry ,Bell Labs India, Alcatel-Lucent Bangalore, India "Net work Aware Resource Allocation in Distributed Clouds" Proceedings IEEE INFOCOM, 2012.

[12] Shahin Vakilinia*, Dongyu Qiu and Mustafa Mehmet Ali "Optimal multi-dimensional dynamic resource allocation in mobile cloud

computing" *EURASIP Journal onWireless Communications and Networking* 2014.

[13] Yang Ge, Yukan Zhang and Qinru Qiu, Yung-Hsiang Lu "A Game Theoretic Resource Allocation for Overall Energy Minimization in Mobile Cloud Computing System" *ISLPED'12,* July 30–August 1, 2012 ACM 978-1-4503-1249-3/12/07.

[14] D.Huang X.Zhang,M.Kang, J.Luo, Mobicloud: Building secure cloud frame work for mobile computing and communication, in Proc .of Fifth IEEE International Symposium on Service Oriented System Engineering, pp 27-34.

[15] D Niyato, AV Vasilakos, Z Kun "Resource and revenue sharing with coalition formation of cloud providers: Game theoretic approach" (IEEE Computer Society, 2011), pp. 215–224.

[16] Kyunglag Kwon1, Hansaem Park1, Sungwoo Jung1, Jeungmin Lee1 and In-Jeong Chung1,"Dynamic Scheduling Method for Cooperative Resource Sharing in Mobile Cloud Computing Environments" *2016*

[17] Preetha Theresa Joy & K. Poulose Jacob "Cooperative Caching Framework for Mobile Cloud Computing" Global Journal of Computer Science and Technology Network, Web & Security, Volume 13 Issue 8 Version 1.0 Year 2013.

[18] Abderrahmen Mtibaa Afnan Fahim, Khaled A. Harras Mostafa H. Ammar "Towards Resource Sharing in Mobile Device Clouds: Power Balancing Across Mobile Devices" 2013.

[19] Ajita Singh, Yuxuan Xing, Hulya Seferoglu "Energy-Aware Cooperative Computation in Mobile Devices" 2016.