



**INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH  
TECHNOLOGY**  
**COMPARATIVE STUDY OF CLOUD COMPUTING AND MOBILE CLOUD  
COMPUTING**

**Nidhi Rajak\*<sup>1</sup>, Diwakar Shukla<sup>2</sup>**

\*<sup>1,2</sup>Department of Computer Science and Applications  
Dr. Harisingh Gour Central University, Sagar(M.P.) : India.

DOI: 10.5281/zenodo.1207037

**ABSTRACT**

Present era is of Information and Communication Technology (ICT) and there are number of researches are going on Cloud Computing and Mobile Cloud Computing such security issues, data management, load balancing and so on. Cloud computing provides the services to the end user over Internet and the primary objectives of this computing are resource sharing and pooling among the end users. Mobile Cloud Computing is a combination of Cloud Computing and Mobile Computing. Here, data is stored in a Cloud Computing Infrastructure which can be access using Mobile devices over Internet. This paper presents brief introduction of cloud computing and mobile cloud computing, its architectures and models. This paper also contains comparative study of the Cloud Computing and Mobile Cloud Computing in respect of service model, issues, and applications.

**KEYWORDS:** Cloud Computing, Mobile Computing, Mobile Cloud Computing, IaaS, PaaS.

**I. INTRODUCTION**

In the present time, cloud computing is the most important platform for computing due to it uses the principle "Pay-as-You-Go" model. Every customer using cloud for stored information related to name, address, mobile number etc. This information can be accessed anytime and from anywhere. The major condition for any cloud environment is high speed of Internet Connectivity. Number of services provided by cloud such as SaaS, IaaS, and PaaS as per the end user requirements. The primary uses of cloud computing such on-demand network, convenient and resources should be pooled and shared. Resources can be servers, storage, network and services which can be used and accessed with minimum effort.

Mobile Cloud Computing is also a burning area of computer science research. It is basically inherited from cloud and mobile computing [1]. It provides services and other facilities to mobile device users which increases the battery life of mobile device and also increases the storage capacity of mobile devices.

The rest of this paper is organized as follows. Section 2 discuss cloud computing and its different models. Mobile cloud computing discuss in section 3. Section 4 having the comparative study of cloud computing and mobile cloud computing. Finally, the section 5 concludes the review paper.

**II. CLOUD COMPUTING**

Cloud computing is the fast growing platform and using many area of current era of Information and Communications Technology (ICT). It provides service using Internet for users and the services are virtualized resources and scalability. Cloud Computing defined by NIST[2] as "Cloud Computing is a model for enabling convent, on demand network access to a share poll of configurable computing resources that can be rapidly provisioned and released with the minimum management effort or service provider interaction" The Cloud Computing is basically working on two important features[3]: *Abstraction and Virtualization*. Abstraction information of the Cloud Computing is generally collect from end user and developer. This information can be detail about implementation of system, about the location of storage and the physical computer system. This facilities for end user that can use the application and service from anywhere and at any time. Virtualization is a very important feature of the cloud computing. Resource sharing and pooling are belongs to virtualization. It use the principal "pay and use" of the storage or resources in cloud computing. Cloud Computing services is

[Rajak\* *et al.*, 7(3): March, 2018]  
ICTM Value: 3.00

classified in to three parts such as Platform as a Service(PaaS), Software as a Services(SaaS), Infrastructure as a Service(IaaS). The other detail discuss in next sections.

### Cloud Computing Models

Cloud Computing models are classified into two models as decided by National Institute of Standards and Technology(NIST)[ 2] such as *Deployment Models and Service Models*.

### Deployment Models

This models are further classified into different models based on following attributes such as infrastructure, availability and location for the end user.

S.No.	Deployment Models[2]	Brief Descriptions
1.	Public cloud	<ul style="list-style-type: none"> <li>✓ Use for public and access by all end user.</li> <li>✓ It is controlled and operated by cloud provider.</li> <li>✓ Best example of public cloud is social network website or email .</li> </ul>
2.	Private cloud	<ul style="list-style-type: none"> <li>✓ Use for specific organization and unauthorized access is not allowed.</li> <li>✓ It is managed and controlled by only organization or third party.</li> </ul>
3.	Community cloud	<ul style="list-style-type: none"> <li>✓ This cloud usage by many organizations.</li> <li>✓ This cloud is managed, controlled and operated by either cloud service provide or the organization.</li> </ul>
4.	Hybrid cloud	<ul style="list-style-type: none"> <li>✓ This is composition different clouds.</li> <li>✓ It uses resources of the cloud such as cluster, computers, and storages.</li> </ul>

### Service Models

This models elaborate what different type of services provided by which service models. It is classified based on the service provided by the models. The service models[4] are *Software as a service(SaaS), Platform as a service(PaaS), and Infrastructure as a service(IaaS)*.

S.No.	Service Models	Brief Descriptions
1.	Software as a Service(SaaS)	<ul style="list-style-type: none"> <li>✓ This is also called service-oriented model.</li> <li>✓ This is used for long term purpose.</li> <li>✓ This model provides two types of service to user which are application and process oriented services.</li> <li>✓ Users uses this service on the principle i.e. pay-per-usage basis.</li> </ul>
2.	Platform as a Service(PaaS)	<ul style="list-style-type: none"> <li>✓ This model provides all kind of support which is required for software development life cycle.</li> <li>✓ There are five primary consumers of this model which are testers, designers, debuggers, and software developers.</li> <li>✓ This model provides independent platform for each developer and it does not allowed to interfered to other platform.</li> </ul>
3.	Infrastructure as a Service(IaaS)	<ul style="list-style-type: none"> <li>✓ This model provides support to users. The supports can be compute, operating system, storage and networking.</li> <li>✓ The primary properties of this model are scalability and elasticity.</li> </ul>

### Cloud Computing Architecture

This architecture is classified into four layers which are as following

- *Application layer:* This is the top most layer of this architecture and it belongs to Software as a Service (SaaS) service

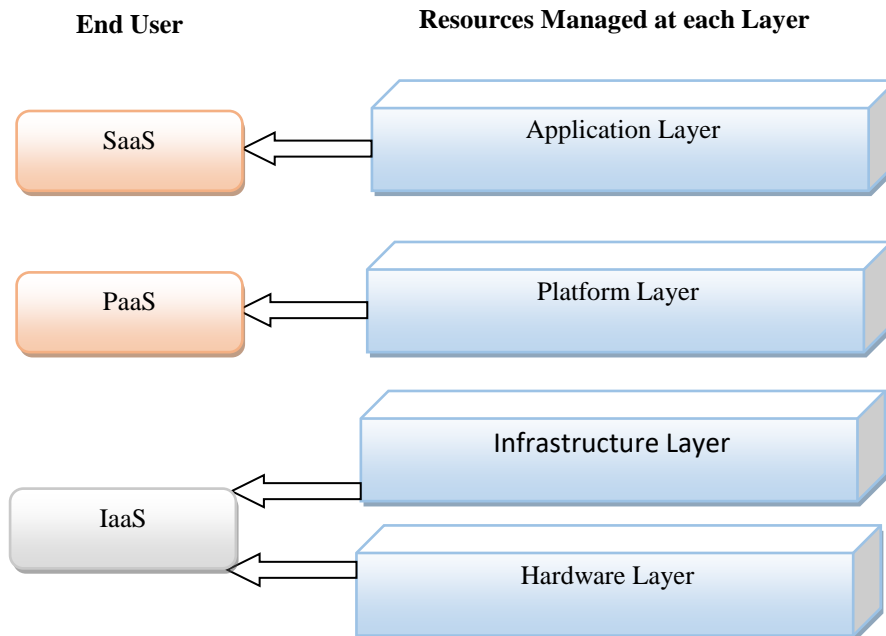


Fig 1: Cloud Computing Architecture [5]

model. The main resources are managed using this layers are Business applications, Web Services and Multimedia. The major examples of this layer are Google Apps, Facebook etc.

- *Platform layer:* This is the second top most layer of this architecture and belongs to Platform as a Service (PaaS). Here main resources are managed using such as Java, Python and .Net as a software framework and DB and file as a storage. Microsoft Azure, Google AppEngine etc as examples of this layer.
- *Infrastructure layer:* This is the third layer of this architecture and which belongs to Infrastructure as a Service (IaaS). Virtual Machine (VM) and Storage are two main resources manager of this layer. The examples are Amazon EC2, GoGrid etc.
- *Hardware layer:* This is the bottom layer of this architecture and also belongs to Infrastructure as a Service (IaaS). This layer basically managed come physical resources such as CPU, Memory, Dick etc. Data Centers are the examples of this layer.

### III. MOBILE CLOUD COMPUTING

Mobile Cloud Computing (MCC)[4] is originated from cloud computing[3,6] and mobile computing[7]. Formal definitions of Mobile Cloud Computing given by many authors and forums, taking two definitions [8,9].

**Definition 1[8]:** 'Mobile cloud computing at its simplest, refers to an infrastructure where both the data storage and data processing happen outside of the mobile device. Mobile cloud applications move the computing power and data storage away from mobile phones and into the cloud, bringing applications and MC to not just smartphone users but a much broader range of mobile subscriber'.

**Definition 2[9]:** 'new paradigm for mobile applications whereby the data processing and storage are moved from the mobile device to powerful and centralized computing platform located in clouds.'

There are some requirements[10] for cloud computing such as adaptability, scalability, availability and self-awareness. Mobile cloud computing having also some requirements such as availability and quality of services.

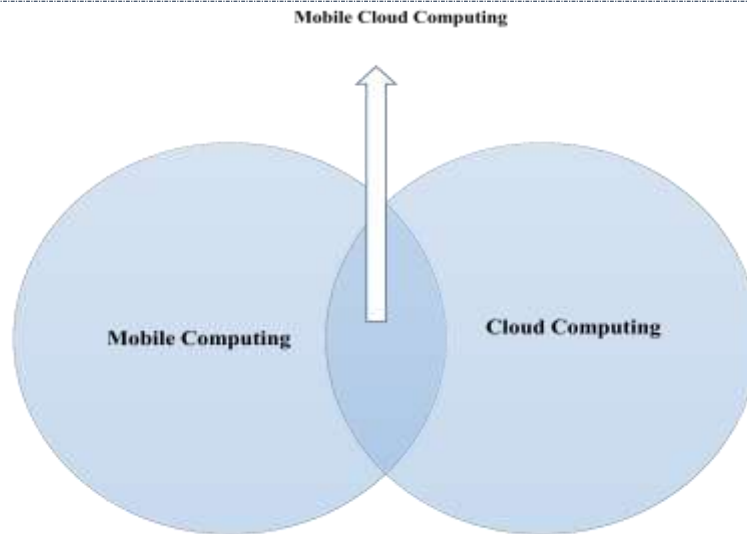


Fig 2: Origin of MCC [4]

### Mobile Cloud Computing Models

Six service models [11] for Mobile cloud computing which helps to mobile user to get services from the cloud.

- *Mobile Network as a Service (MNaaS)*: This model provides network infrastructure for the mobile user and also permit three functionalities to the mobile users such as create own network, control traffic and finally to connect to servers. An example of this model is OpenStack Networking Service.
- *Mobile Cloud Infrastructure as a Service (MIaaS)*: This model of MCC is provides two functions to the mobile users such as cloud infrastructure and storage. The examples of this model are Google drive and iCloud.
- *Mobile Data as a Service (MDaaS)*: This models provides data management and transaction and its some operations to mobile users. The example of this model is Oracle's mobile cloud data.
- *Mobile App as a Service (MAaaS)*: This model provides the facility to the mobile user to access, use and execute cloud based mobile apps using Internet. An example of this model is Google Play Store.
- *Mobile Multimedia as a Service (MMaaS)*: This model provide the facility to the mobile users to run and manage the multimedia services using Internet.
- *Mobile Community as a Service (MCaaS)*: In this model, a group of mobile users and have objectives are to build and manage social network based on mobile and they can get social network or community services.
- 

### Mobile Cloud Computing Architecture

This architecture is made by using integrations of five different components [12] such as

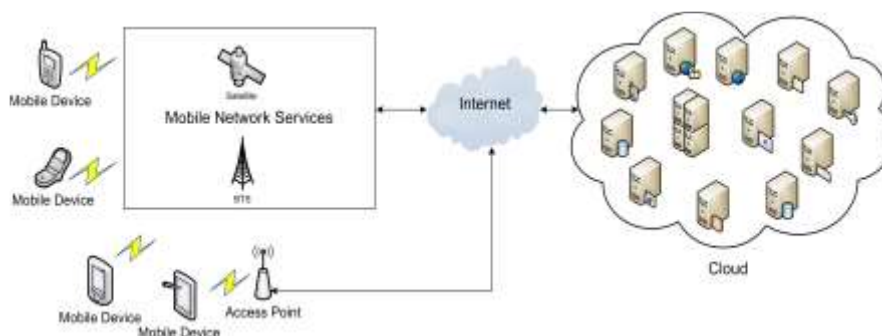


Fig 3. Mobile Cloud Computing Architecture [12]

- *Mobile devices:* There are two ways for Mobile devices to access the cloud services and both ways goes through Internet. The first way would be through *Mobile network service* and second would be through *Access points*.
- *Mobile Network Services:* This component is basically telecom network service provider and they can provide service either using Satellite or using BTS.
- *Access point:* This is another way through which mobile devices are connected with Internet.
- *Internet:* This is also most important component of MCC architecture which provides intermediate between Mobile devices and cloud.
- *Cloud:* This component basically provides services to the mobile devices as per requests

#### IV. COMPARATIVE STUDY : CLOUD COMPUTING AND MOBILE CLOUD COMPUTING

This section discusses the comparisons between cloud computing and mobile cloud computing based service models, issues, benefits and applications.

**Table 3. Comparisons Based on Service Models.**

Cloud Computing	Mobile Cloud Computing
<ul style="list-style-type: none"> <li>✓ Software as a service(SaaS)</li> <li>✓ Platform as a service(PaaS)</li> <li>✓ Infrastructure as a service(IaaS).</li> </ul>	<ul style="list-style-type: none"> <li>✓ Mobile Network as a Service (MNaaS)</li> <li>✓ Mobile Cloud Infrastructure as a Service (MIaaS)</li> <li>✓ Mobile Data as a Service (MDaaS)</li> <li>✓ Mobile App as a Service (MAppaaS)</li> <li>✓ Mobile Multimedia as a Service (MMaaS)</li> <li>✓ Mobile Community as a Service (MCaaS)</li> </ul>

**Table 4. Comparisons Based on Issues[13,14]**

Cloud Computing	Mobile Cloud Computing
<ul style="list-style-type: none"> <li>✓ Automated service provisioning.</li> <li>✓ Virtual machine migration.</li> <li>✓ Server consolidation</li> <li>✓ Energy management</li> <li>✓ Traffic management and analysis</li> <li>✓ Data security</li> <li>✓ Software frameworks</li> <li>✓ Storage technologies and data management</li> <li>✓ Novel cloud architectures</li> </ul>	<ul style="list-style-type: none"> <li>✓ operational level issue</li> <li>✓ end user level issue</li> <li>✓ service and application level issue</li> <li>✓ Privacy and Security level</li> <li>✓ Context-awareness level</li> <li>✓ Data Management Level</li> </ul>

**Table 5. Comparisons Based on Benefits [15,16]**

Cloud Computing	Mobile Cloud Computing
<ul style="list-style-type: none"> <li>✓ Resource pooling</li> <li>✓ Measured service or billing</li> <li>✓ Broad network access</li> <li>✓ Rapid elasticity</li> <li>✓ On-demand self-service</li> </ul>	<ul style="list-style-type: none"> <li>✓ Extending battery lifetime:</li> <li>✓ Improving data storage capacity and processing power:</li> <li>✓ Improving reliability:</li> <li>✓ Dynamic provisioning:</li> <li>✓ Scalability</li> <li>✓ Multitenancy</li> <li>✓ Ease of integration</li> </ul>

**Table 6. Comparisons Based on applications [17,16]**

Cloud Computing	Mobile Cloud Computing
✓ Banking	✓ Mobile Commerce
✓ Insurance	✓ Mobile Learning
✓ Weather Forecasting	✓ Mobile Healthcare
✓ Space Exploration	✓ Mobile Gaming

## V. CONCLUSION

The main concern of cloud computing is to share and pool resources between users via Internet. This improves utilization of resources among users. Similarly, mobile cloud computing is also playing an important role in current technology. The primary objective of mobile cloud computing is to reduce battery power of mobile devices and storage capacity of mobile devices. This paper provides a comparative analysis between cloud computing and mobile cloud computing. The analysis has been done based on service models, issues, benefits, and applications of cloud computing and mobile cloud computing.

## VI. REFERENCES

- [1]. Satyanarayanan M. :Mobile computing: the next decade. Proceedings of the 1<sup>st</sup> ACM Workshop on Mobile Cloud Computing & Services : Social Networks and Beyond(MCS), 2010.
- [2]. The NIST Definition of Cloud Computing Peter Mell Timothy Grance NIST Special Publication 800-145,2011.
- [3]. V.K.Pachghare ,:Cloud Computing, PHI, 2016.
- [4]. Debasis Dey,:Mobile Cloud Computing: Architecture, Algorithms and Applications,CRC Press, Taylor and Francis Group, Edition, 2016.
- [5]. B. Sotomayor, R. S. Montero, I. M. Llorente, and I. Foster,"Virtual infrastructure management in private and hybrid clouds". Internet computing, IEEE, Vol.13 No.5, pp.14–22, 2009
- [6]. Maricela-Georgiana Avram."Advantages and challenges of adopting of cloud computing from an enterprises perspective". Procedia Technology, Vol.12,pp.529-534, 2014.
- [7].Robert Godwin-Jones," Emerging Technologies Mobile-Computing Trends: Lighter, Faster", Smarter. Language Learning & Technology,Vol.12,No.3, pp.3-9, 2008.
- [8].Lecture notes on mobile cloud computing available at <http://www.mobilecloudcomputingforum.com/>.
- [9]. White Paper, Mobile Cloud Computing Solution Brief. AEPONA, 2010.
- [10]. L.Mei, W.Chan, T.Tse, "A tale of clouds: paradigm comparisons and some thoughts on research issues". Proceeding of the Asia-Pacific Service Computing Conference , APSCC'08 IEEE,pp.464-469,2008.
- [11]. M.B.Mollah,"Security and Privacy Challenges in Mobile Cloud Computing: Survey and Way Ahead", Journal of Network and Computer Application, Vol. 84,pp.38-54, 2017.
- [12]. Atta ur Rehman Khan, Mazliza Othman, Sajjad Ahmad Madani and Samee Ullah Khan,"A Survey of Mobile Cloud Computing Application Models". IEEE Communications Surveys & Tutorials, Vol.16,No.1,2014.
- [13]. Qi Zhegen," Cloud Computing: state-of-the-art and research challenges". Journal of Internet Service Applications, Vol.1, pp.7-18. 2010.
- [14]. Niroshinie Fernando, Seng W.Loke and Wenny Rahayu,"Mobile Cloud Computing: A survey", Future Generation Computer Systems, Vol.29,pp.84-106, 2013.
- [15]. Eweoya Ibukun and Olawande Daramola.: A Systematic Literature Review of Mobile Cloud Computing. International Journal of Multimedia and Ubiquitous Engineering. 10(12) ,135-152, (2015).
- [16]. H. T. Dinh, C. Lee, D. Niyato, and P. Wang, "A survey of mobile cloud computing:Architecture, applications, and approaches", Wireless Communications and Mobile Computing, Vol.13,No.18, pp.1587–1611, 2013.
- [17]. Kaur, Kiranjot, and Anjandeeep Kaur Rai."A comparative analysis: Grid, cluster and cloud computing". International Journal of Advanced Research in Computer and Communication Engineering , Vol.3,No.3, pp.5730-5734,2014.