

Evaluating Mobile Cloud Computing Models

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Abstract. Mobile cloud computing has been a popular technology in the market for almost a decade now. However, even as the technology continues attracting more users, certain aspects of mobile cloud computing are relatively challenging to users and developers. These aspects relate to the architecture of the setup of ordinary platforms in the mobile cloud computing market. By overcoming aspects of portability and compatibility, many users get to enjoy services from cloud based servers on their cell phones. However, the complete image transcription of the server environment is yet to be actualized. It is necessary that developers continue to consider size and processing limitations when developing server-side applications that offer mobile cloud computing services.

1. Introduction

1.1 Background to the Problem

Mobile cloud computing (MCC) is the fusion of three major technologies to provide a range of suitable services for GSM Global System for Mobile (GSM) cell phone users [1]. These three technologies are mobile computing, cloud computing, and wireless networks. The fusion of mobile computing and cloud computing is made possible through wireless networks. However, there are hardware limitations that affect the effectiveness of MCC technology.

1.2 Problem Statement

Mobile cloud computing is often a trade-off between cost and design features on a cell phone. Trade-offs determines the nature, popularity, and capacity of mobile phones. For instance, feature phones are limited in memory capacity, processing capability, storage size, and sensor compositions [2]. They are thus cheaper than smart phones that are more superior in all of these feature phones. Mobile Cloud Computing (MCC) nonetheless requires fairly high specification for its implementation. Cell phones ordinarily require stable and high-speed data to access cloud computing services.

Mobile cloud computing experts and platform application developers nonetheless face various challenges with regard to session handling. Sessions between a cell phone and a cloud server are based on various protocols and algorithms that need to establish a set of routine threads between the server and the client (cell phone) [3]. The communication is, however, based on the ability of the communicating devices to encode and decode text messages and multimedia messages. The real challenge is converting the actual environment on the server to a remote environment on the cell phone [4]. Several issues relate to the process but of concern is the generation of the scheduling and virtual environment.

1.3 Scheduling issues

The multi-level feedback queue algorithm is used in cloud computing environments to manage sessions between various users. Where protocol is not an issue and the hardware compatibility is okay, issues often arise in deadlocks when server-client requests are made progressively. Queuing thus becomes mandatory in mobile cloud computing environments. A typical multilevel feedback queue works while if the queue increases the wait time as more devices connect to the resource/service. Given the growth in mobile computing and the continuing

popularity of the resource, this will be a challenge [5]. There is a need to standardize these protocols and resources around making it possible to apply Multicast routing algorithms to access cloud computing resources on cellular networks. This will require standard MCC protocols, standard MCC scheduling algorithms, and standard MCC platform languages. Currently, Java, Android, C#, and X-Code are popular yet not cross-platform languages [6].

2. Related Work

2.1 Congestion issues in mobile networks

Congestion is a network challenge and not specifically a device-related concern. However, mobile cloud computing cannot ignore the importance of networks as the underlying channels of communication. The ability of the channels to deal with congestion is thus a factor that affects MCC technology [3]. Congestion leads to the inability for channels to establish new sessions and at times results in cross-interference (cross-talk) where certain sessions are interfered with by different users unintentionally. This poses a security concern [6]. Regardless, the use of networks is controlled by the average usage based on traffic growth. This determines how the network grows based on the internet service provider's (ISP) ability to offer such growth and platform robustness [7].

2.2 Context-aware computing

Context-aware computing can be considered as the main challenge facing mobile cloud computing today. Context-awareness is the ability to transform features such as software design and layouts to fit the environment they are used in. It also involves the use of different hardware components based on the environment [8]. For instance, the accelerometer on a smart phone not only shifts the screen on the phone based on the angle of tilt of the phone but rearranges the applications on the cell phone once the user switches from portrait to landscape view. The challenge, however, is when one accesses resources on a cloud network that are not developed to suit the layout of mobile computing devices. This constrains the user to scrolling many pages, large fonts as well as pixilated images [2].

3. Proposed Models/Methods

To deal with the cloud computing challenges, there are several models that can be advanced and developed for the benefit of the user. While developing the models, the focus was on the improvement of the various challenges faced by the available models in the market. In order to deal with the pre-existing challenges, it is important to realize that each model faces certain challenges with its design and the methods applied in running various threads. There are many models applied in the market. Depending on the role and algorithms used, these models can be classified in four major categories. In order to improve certain functions in the models, this solution proposes various improvements to the models. Here is a look at these models.

3.1 CloueCloud Model

The CloueCloud model can be based on the architectural diagram drawn below:

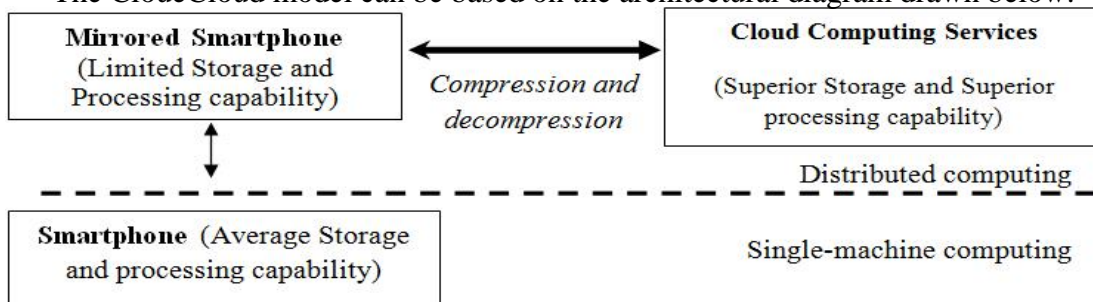


Fig 1. CloueCloud Model Architecture.

The model may have been in use for many years, but the improvement shown above involves the use of the compression and decompression algorithms to guarantee context-awareness,

and virtual machine transfer. This ensures that the least-advanced smart phones can access these facilities (cloud) and resources using the limited hardware and software resources they have. Compression and decompression algorithms apply to graphics, sound and hyper-text graphics. The modifications propose the inclusion of compression, and decompression algorithms as well as a lower-specified mirrored cell phone. These changes will enable the mirrored cell phone to communicate better with the actual cell phone.

3.2 AlfredO Model

The AlfredO Model automatically distributes the different computing applications as a middleware between the cloud and the mobile computing device. The challenge with the AlfredO architecture is that the point of contact with the cell phone needs to be within a compatible architecture. This, however, can be dealt with by involving the mirrored smart phone as shown below.



Fig 2. Introducing the Mirrored Smartphone layer to the Alfredo Architecture.

The mirrored Smartphone layer will guarantee that all aspects of language or hardware incompatibility between the middleware and the Smartphone are handled before the cloud-computing session can be initiated. The mirrored Smartphone layer needs to encompass compatibility with smart phones with the least processing and hardware capabilities. This will ensure that many smart phones are able to access the cloud computing services. All cell phones can then connect to the mirrored smart phone in order to access the services from the cloud computing resource similar to the CloueCloud model.

3.3 Cloudlet Model

The cloudlet model is based on the development of cloud-service networks within a localized server environment. The service is offered by a roaming device or via wireless routers connected to the server. This can be done as follows:

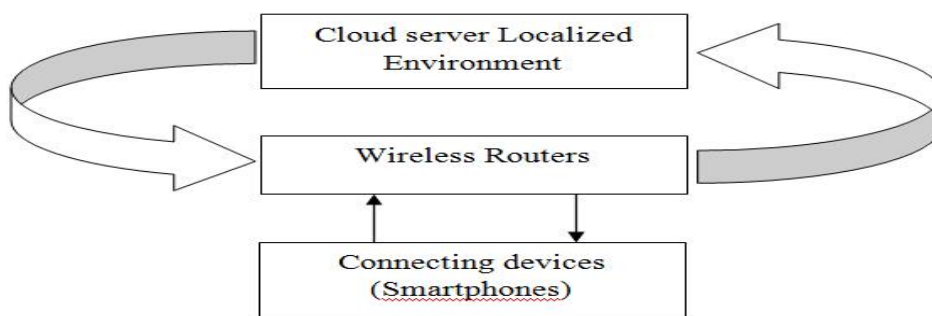


Fig 3. Cloudlet model.

To improve the functionality of the devices in the model, there is a need to employ several changes in the layout. First, the wireless routers need to be employed and several wireless access points within the proximity distance of all the cell phones in the vicinity. The other aspect is the need to have each access point offering routing to a gateway that is the queue server. For the cell phones to avoid cross-talk and electromagnetic interference, there is the need to have a network mast offered by the internet service provider to deal with frequency allocation and modulation in each session. The figure below indicates the cloudlet model with the gateway component and the network mast to deal with the issue of network congestion.

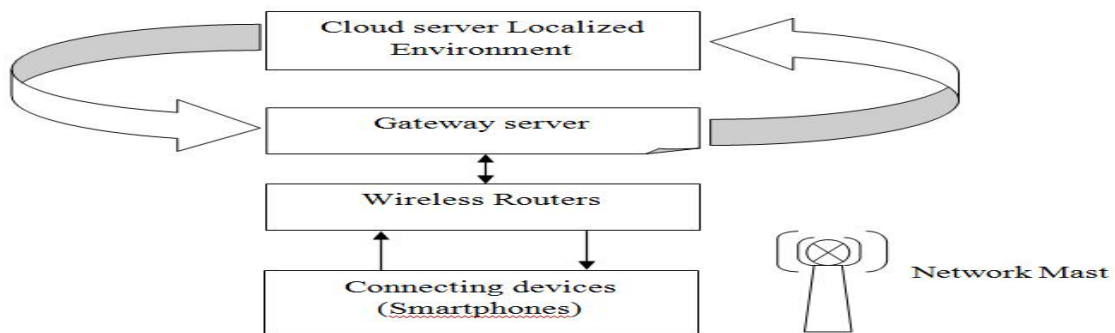


Fig 4. Improved cloudlet model.

The inclusion of the network mast assists in the boosting the network signal that would otherwise attenuate due to the nature of the wireless network being unstable. The challenge, however, is in the gateway service allocation. The use of a scheduling algorithm is crucial and quite necessary, but it is often based on the clock number assigned to each request. The challenge with networks where signal challenges may pose a threat is that delayed request may lead to duplication of clock numbers hence leading to deadlocks. The use of the server (gateway) and the mast will handle attenuation and proper scheduling.

3.4 Hyrax Model

The Hyrax model is based on the distinguishing of cloud resources as services and not as hardware platforms to be used over channels. This implies that the specific software is based on particular servers online, and can be accessed remotely by establishing sessions. The particular sessions, however, require a middleware governing the allocation of the same as well as hardware platforms to support the software. The Hyrax model disregards protocols and other limitations and only considers the service, as well as the communicating node with regard to the communication channels, established. The model should be improved in the following way.

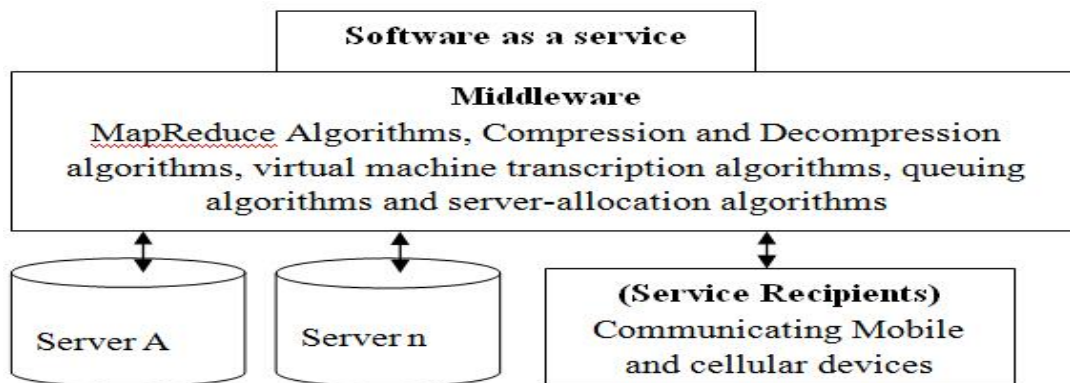


Fig 5. Hyrax advanced model.

The inclusion of the middleware layer between the service and the communicating devices enables for the various routines and threads to be run based on protocols. All the servers will get synchronized and enable the client receive the software and other services they need without virtual transposition challenges. There is also need for the algorithms to handle resource allocation in order to guarantee fair distribution of the software resources.

4. Experimental Environment

4.1 Evaluating the Models

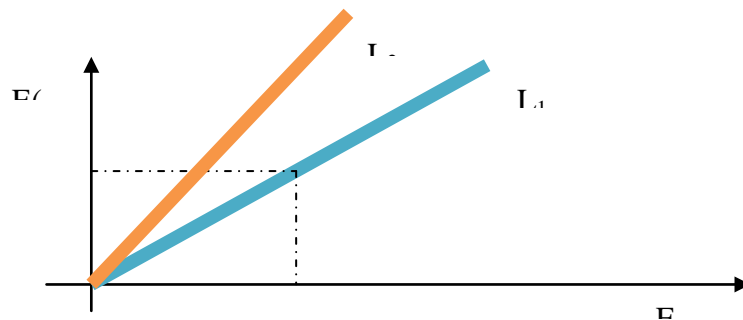
The CloueCloud model can best be evaluated by estimating the average number of packets exchanged between the Smartphone and the Mirrored smart phone as well as the number of packets between the mirrored smart phone and the cloud server. The equations below best illustrate this evaluation:

Eqn.1 Efficiency of phone network $E(P) = \alpha/\delta$ While; (1)

Eqn. 2 Efficiency of server-side network $E(S) = \delta/\beta$ (2)

Where; α is the Number of packets sent to the mirrored Smartphone by the mobile Smartphone each minute while δ is the value of the packets sent to the mobile Smartphone by the mirrored Smartphone per minute. The value $E(P)$ represents the efficiency of the phone-phone network. Similarly, $E(S)$ which evaluates the efficiency in communication between the server and the mirrored Smartphone is given as a ratio of the packets sent to the server by the mirrored Smartphone; δ against the packets sent back to the mirrored Smartphone by the server; β . The evaluation can be done on two fronts; where the mirrored Smartphone is of a higher specification than the mobile Smartphone (as a control experiment) as well as where the two phones comprise of similar specifications.

Expected results: It is expected that the value $E(S)$ and the value $E(P)$ will be almost similar. In the control experiments, however, there is the possibility of higher value for $E(S)$ than $E(P)$ in the case of higher mirrored Smartphone specification while a lower value for $E(S)$ in the case of similar specifications between the Smartphone and the mirrored Smartphone. The AlfredO, Cloudlet, and Hyrax models can be evaluated based on the number of packets sent between the server and the mobile device; disregarding the effect of the firmware. However, where the network mast and the mirrored phones are introduced, these setups will be compared to the setup without these advancements. It is hypothesized that the improved network modifications will increase the number of packets interchanged.



Graphical Comparisons

From this study, the relationship between $E(S)$ and $E(P)$ is represented by L_1 thus inherently similar for each instance of the mirror Smartphone. However, according to studies in [4, 7, 12, 13] the actual representation is as in the graph L_2 brought about by the many factors affecting mobile cloud computing.

4.2 Sample Data simulation

The data below represents the efficiency of the server in the allocation of service to nodes. The queuing algorithm (multilevel feedback queuing algorithm) is expected to be behind the representations as shown below.

Table 1. Sample simulated data from the CloueCloud model scenario.

Device Scenarios	E (S)	E (P) in Seconds
Mirrored Smartphone lower specifications than Mobile Smartphone	0.8	0.6
Mirrored Smartphone similar specifications to Mobile Smartphone	0.9	1.0
Mirrored Smartphone similar specifications to Mobile Smartphone	0.7	0.5

From the data above, it is clear that the mirrored Smartphone does affect the functioning of the mobile cloud computing session. The aspect in evaluation is speed and based on the superiority

of the mirrored cell phone then there can be a higher or lower E (S) or E (P) value. There is, however, an assumption that compatibility issues never arise as influencing the speed and neither do the processing/ clock speeds of the devices vary.

5. Conclusion and Future work

The need to have a proper model for mobile cloud computing interfaces cannot be understated. The challenge is often that mobile cloud computing interfaces have not yet been standardized globally [4]. This is due to the vastly growing and dynamic environment that involves the development of new protocols and frameworks almost every day. The fact that innovations will continue to be targeted towards mobile cloud computing is only an indication that the field will get better. Many programmers are also developing new ways to interact with more features of the hardware-centered Smartphone market [9]. Without these ‘new ways’ and platforms, there may never be actual protocols to support cross-platform mobile cloud computing. However, with the four existing models setting the trend, the need only arises to improve them for better communication among devices running MCC networks on the interwebs. Future research, however, needs to be done with regard to the development of better cellular protocols to support compression across different Smartphone’s as well as the ease of access to cloud-based resources by smart phones as opposed to other portable computing devices. This is because mobile phones are indeed the most popular computing devices in the world today [10].

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