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Mobile Devices Authentication Based on Services Oriented Architecture Using Mobile Cloud Computing

Muhammad Basit Mujeeb[1] and Muhammad Junaid Arshad[2]

[1,2]Department of Computer Science & Engineering, University of Engineering & Technology, Lahore, Pakistan

[1]basitue@gmial.com, [2]mjunaiduet@gmail.com

***Abstract*—Mobile cloud computing is a mobile paradigm which provide mobile user services with rich computation power. Its storage capacity with limited resources in hand that based on "pay-as-you-use" policy. There are some problems of security, quality of services, and application error to MCC services provider. There is need for mobile user and devices authentication within MCC. We are going to propose architecture for mobile devices/users/services authentication based on services oriented architecture in MCC. By using this proposed architecture we can authenticate the mobiles devices which are using different services through MCC. The services on MCC can be categorized for different mobile users and services that are restrict to the users to use the particular services which are offered according to their device specifications. By our proposed architecture we calculate the bandwidth, computing power limitations of mobile devices; we restrict that particular user to use services which are in the range of mobile device. We divide the application and services among the devices in MCC. So, we can achieve the quality of communication between mobile devices and MCC services by judgment of bandwidth of devices and reduced data delivery time in MCC.**

***Index Terms*— Mobile Cloud Computing (MCC), Cloud Computing and Mobile Cloud Service Oriented Architecture (SOA)**

I. INTRODUCTION

MOBILE cloud computing has combination of mobile computing, cloud computing and wireless network. Today the researcher introduced the green computing and internet of things (IOT) with the help of cloud and mobile computing [1], [2]. Mobile cloud computing, removing the limitations of mobile device like processing speed, battery life timing, privacy aware authentication, storage capacity and exploit cloud services for mobile users [3], [6].

Cloud computing is the research topic now a days. The usages of mobile devices is quick increasing and due to fast saturation of mobile application mobile cloud computing (MCC) is known as a potential technology for mobile devices and to overcome the resources problem of mobile by moving the storage and process of data to the cloud out from the mobile [7], [8]. The mobile devices have resources challenges like battery life, low computing power, storage capacity and limited bandwidth [9].

When a mobile user access to MCC and avail any service and application on cloud then he faces some problems like service error, application not access, poor quality of services. To overcome these problems there is need for division of application; considerations of mobile devices specification in MCC. Mobile devices have their limitations in specification, bandwidth, storage capacity, and processing speed [10]. Mobile devices has different operating systems, specification on this behalf we can divides applications and services within MCC.

The user can select those application and services which are according to his device specification and bandwidth. Know a day the MCC is open access [11], [12] for mobile users and all application can be access but user not aware of services which are suitable for his device and which are not. So, he faces many problem regarding application error and quality of services in MCC. The services are divided according to bandwidth connection and devices specification, so user allows for that specific services which are according to his device and bandwidth, the other services are not open for that particular user.

Users know the services which are suitable for his device. User can enjoy the error free services and no interrupts regarding connection failure. In this way the services provider achieves privacy and security against applications within MCC. We have all statistics about number of mobile devices, number of any application users, number of services, and most popular services within MCC. The services providers can check the usability, popularity, demand of all application and services.

This paper is categorized as follows: literature review and related work is discussed in section 2, Section 3 introduces the new mobile cloud computing architecture; briefly describe the component and working scenarios of proposed architecture, Section 4 shows the comparison of traditional MCC model and proposed model, discussion of new MCC model, Section 7 is related to the conclusion and future view of MCC.

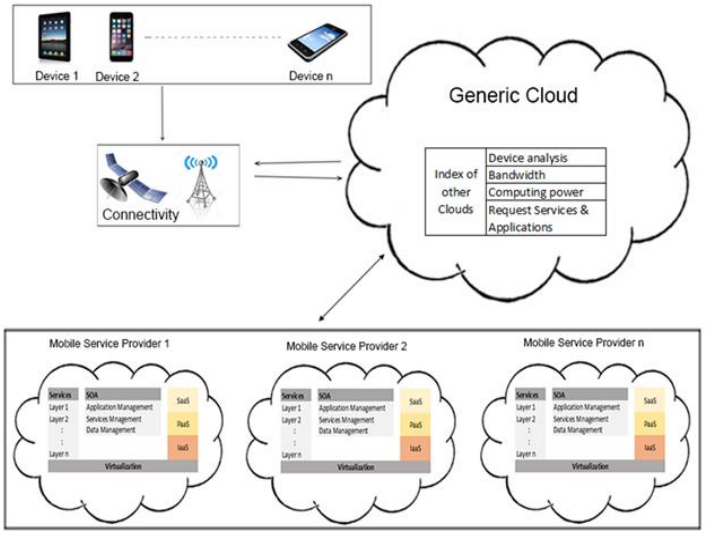

Fig. 1: Mobile Cloud Computing Architecture

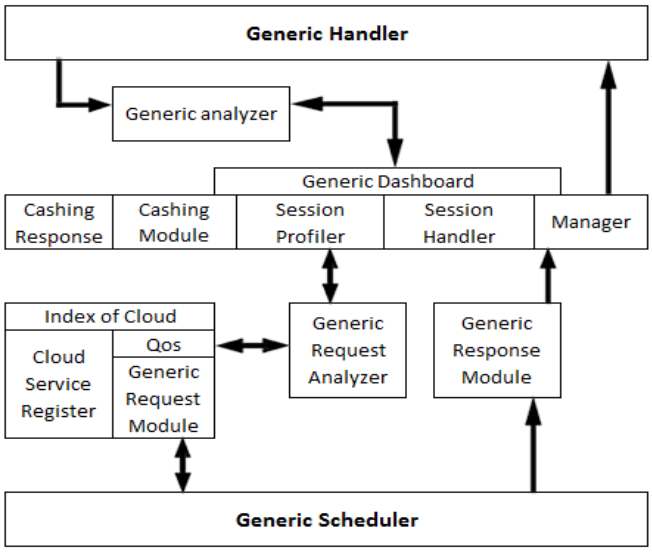

Fig. 2: Generic Cloud Stack

II. Literature Review and Related work

MCC integrate the technology of cloud computing with mobile environment. According to a new report from ABI Research entitled "4G Smartphone" shipments of 4G Smartphone will reach from 4.6 million in 2010 to 245 million in 2016 [13]. According to Cisco global cloud index 2013-2018, SaaS most highly deployed global cloud service by 2018 [14]. Various solutions are proposed by many researchers for various problems of MCC architecture. As mobile cloud computing application are becoming widely used to mitigate the limitation of mobile devices and exploit cloud services, computing power, storage capacity for mobile users. Mobile cloud computing provides resources computing infrastructure to cloud consumers that basis on demand. We have seen various solutions for mobile clod computing (MCC) applications.

There are such technologies and web applications which help mobile to run cloud apps like cloud clone that brings power of cloud to user mobile phone, Cloudlet is rich resource for nearby mobile devices, an emerging technology known as embedded hypervisor which allows additional software that run on a virtual environment [15].Mobile devices are included in cloud which increased the utilization of cloud app and services. Due to availability of cloud more application social network to mobile application, it is easy to monitor control and regulate any services in cloud. Cloud computing provide platform free application which is not limited to any particular operating system or mobile brand.

Chun et al. [16] introduced clone cloud in which the components of an application migrate automatically or dynamically between a mobile and the cloud. Clone is the mirror images running on a virtual machine. The advantage of clone cloud is enhancing Smartphone performance and drawbacks are handover delay, bandwidth limitation. Zhang et al. [17] proposed a reference framework for elastic application development in which the components of application can be divided into a range of elasticity pattern called weblets. It can be launched on mobile or cloud based on configuration. The mobile devices capability enhances in it but still this framework required mechanism for the communication between weblets because devices change their communication channel.

Tuli et al. [18] proposed MCC architecture which provides proxy to different mobile users connecting for services to cloud. It is Restful WS. The middleware form a bridge between the mobile client and WS. The Middleware extract service result and deliver it to the mobile client finally. Sharma et al. [19] proposed that for mobile cloud application and platform independent solution could be a middleware. The middleware provide a platform which capable for managing resource intensive tasks that provide communication between different applications. Mobile middleware solution provides more efficient powerful cloud computing for mobiles. K.akherfi et al. [20] proposed middleware architecture which shows that the use of Restful with JSON performs well. It represents proxy to adapt SOAP over Restful which optimize the response time lighter in size. The adapted protocol is close to the nature of mobile users. By hosting middleware in a specified cloud provided the (MaaS) middleware as a service. The middleware present solve the one of issue adaptation. Abolfazli et al. [21] proposed a lightweight resource oriented architecture using service based mobile cloudlets (ASMobiC) and Restful cross-platform on major mobiles OS (e.g., Android and iOS) to perform resource-intensive mobile application (RiMA). The intensive task executed in ASMobiCs and more energy saving. Lomotey and deters [22] proposed mobile architecture design contain of a cloud hosted middleware, mobile nodes and the HIS health information system. Med app using middleware stack which use http interface and support of REST over SOAP services composition which provides efficient services between various components. The medical app is design by follow REST standard which is close to the mobile device. Ettazi et al. [23] proposed a cloud based

Fig. 3: SOAP Envelope

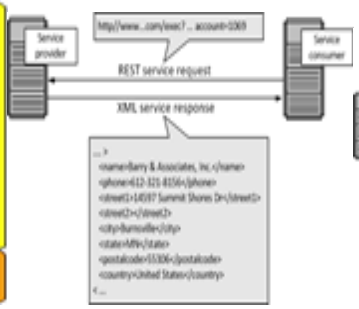

Fig. 4: REST Interaction

Fig. 5: JSON Interaction

middleware for transactional service adaptation (CM4TSA) by adding the "Adaptation as a Service" layer into basic cloud architecture, to perform the correct execution of transactional service according to the user context. They propose a prototype for their architecture.

III. Proposed Architecture

In this proposed architecture the MCC services are distributed among the mobile users according to their mobile specifications, computing power and connection bandwidth. MCC architecture is designed as in Fig. 1 it can be support any group of users in all the criteria of cloud like the IaaS, SaaS, DaaS, NaaS and PaaS. Everything is provided by the mobile cloud. The user has to pay as much as they need services and don't want to pay unused. This architecture is consists of mobile devices, generic cloud, mobile service providers, divides layer of applications and services, app & data management, virtualization component of MCC. The architecture of MCC is illustrated in Fig. 1.

Mobile devices

Mobile devices are progressively turning into a crucial piece of versatile cloud. Every device has its own capabilities, battery timing, storage capacity, processing power and bandwidth. Mobile devices platform are discuss below.

Mobile devices Platform

Mobile devices have different platforms like android, blackBerry, bada, iOS, Symbian, MeeGo, WebOS and Windows Phone. These platforms have many versions of operating system which are accordingly increases with the mobile technology with the passage of time. Recently android, iOS, BlackBerry, Windows phone has their own play store and application which are supporting their platform.

Recommended standard for device APIs

The html, css and JavaScript are the main supporting languages for developing the application on web and supported all platforms of mobiles. HTML5 have introduced many cross platform app development tools which can place on any mobile or device without any platform dependency. HTML5 apps using XDK and cujoJS that offer a great deal, more advanced, client experience on each of the versatile platforms generally being used today. HTML5 is based on open standard; its implementations supported almost everywhere. Cost building for HTML5 is free. HTML5 based 3rd party framework like Ionic which provides GUI based apps that facilitate to instantly update their apps directly without visiting the app stores.

User connectivity

User connected through 2G/3G/4G or Wi-Fi to cloud. When user access the cloud for application or service, the request goes to generic cloud.

Generic cloud

Generic cloud has the all information of other service provider clouds. The generic cloud works as middleware between mobile devices and mobile services providers. The modules of generic cloud are shown in Fig. 2 and detail given below.

Generic handler

This part gets a solicitation from the versatile customer and sends an improved result to the portable client.

Generic analyzer

When a device connects with MCC and requests a service the generic analyzer gets the analysis of device which consists of device specification, its connection information, computing power, bandwidth and requested services.

Generic dashboard

Generic dashboard manages mobile devices, service provider, and all statistics report in MCC. Dashboard has following component and execution.

Manager

This module manages the different requests from the mobile devices and response received from the mobile service providers.

Session handler

Session handler creates the sessions of all devices when resources assign to the mobile devices or terminates the sessions when resources or processing complete back to the mobile devices.

Session profiler

When session created for a mobile device then it allocate a one of a kind identifier for sparing the versatile profile.

Cashing module

It store the original request from the mobile device and get the optimize response from the service provider to the user for which purpose the generic cloud is responsible.

Cashing response

It's selected the responses store in the cashing module and reacts relying upon the incoming request of the versatile users.

Index of other cloud

This module manages other service provider clouds in it and manages the all services and applications provided by service provider. It's make sure the services are available and quality of services is provided.

Cloud service register

This module registers the other cloud services, maintains the list of services and applications available on the service provider domain. It communicates with service provider clouds for the availability of services and updates the list of services and applications of different service providers.

QOS module

This component makes sure the services availability and quality of service for mobile user. Its conform the services are accordingly the request and monitor the quality of services, if the service level is below the requirement of user then it's notify to request module to reselect the service for better performance.

Generic request module

It select the service which is requested by the mobile user, its check the requirements of service accordingly the report of generic analyzer and select the best suitable cloud service provider for send the request.

Generic request analyzer

It's analyze the request and match with the cloud services registers in MCC and decide the service can be provide and select the best option for scheduler to schedule the request.

Generic scheduler

It handles the interaction with the mobile service provider and schedule all request to service provider and get back response to generic cloud.

Generic response module

This module provide the optimize result and select the suitable approach of (SOA) either SOAP or REST WS which accordingly to the mobile service provider. In case of cross platform the SOAP convert into REST WS first then response to the mobile user due to REST WS interface support to the mobile devices and compatible with HTTP protocol.

HTTP request and response

The approaching solicitation sort, for example, (GET, POST and PUT) is plainly implanted in the HTTP ask for so the middleware nonexclusive cloud can reaction to the definite request need. After getting the analysis of request, the generic cloud refers the request to that particular mobile service provider.

Service Oriented Architecture (SOA)

The service oriented architecture (SOA) [24] is supports the creation of heterogeneous services. The SOA structure gives backing to different parts of web administrations to interoperate. As per wicks et al SOA concentrate on the reusability of programming and integration [25]. SOA rolls out improvement of programming quick and negligible cost. SOA helped web services developer to overcome interoperability problem by using Simple Object Access Protocol (SOAP) and Resource Oriented Architecture (ROA) approach which is Representational State Transfer (REST). SOAP uses protocols such as hypertext transfer protocol (HTTP); Simple Mail Transfer Protocol (SMTP). The SOAP contains two parts as shown in Fig. 3.

- A discretionary header giving verification of data, information encoding, or how a beneficiary of a SOAP message ought to handle the message.
- The message is contained by the body. These messages defined by using the WSDL specification.

Representation State Transfer (REST) is simpler style then SOAP and its use is easier. It's less verbose so, that less volume uses during imparting. The communication is outlined in the Fig. 4. JavaScript object documentation (JSON) is a lightweight, simple and well known approach to trade information in APIs. We utilize parcel of administrations like twitter, Facebook, flickr are all send back information in JSON group. A subset of JavaScript is uses by JSON. This is illustrated in the Fig. 5.

Proposed web services

The best suitable web service is which supports by service provider. Because we are using multiple service providers so, we are using all three web services specifications SOAP, REST and JSON.

For example Amazon Simple Storage Service (S3) supports REST API. Chrome web services support both SOAP and REST.

Mobile Service Provider

Mobile service provider application and services are divided through layered approach; the request is resolved by required layer of services and application. Every mobile service provider has capability of virtualizations to solve those services request which are available on other services provider. The SOA unit provides services and resources to the user according to their device specification and bandwidth. User selects that particular service according to his device capability provided by mobile cloud otherwise request is resolved through virtualizations component of cloud.

Cross platform application and services

As per recommended of proposed architecture the cross platform application and services which are developed by using HTML5 platform can any of the user and device used in MCC. Any service provider can provide these application and services in cloud.

Load Balancing

Generic cloud has option in cross platform services which are available on more than one service provider. Generic

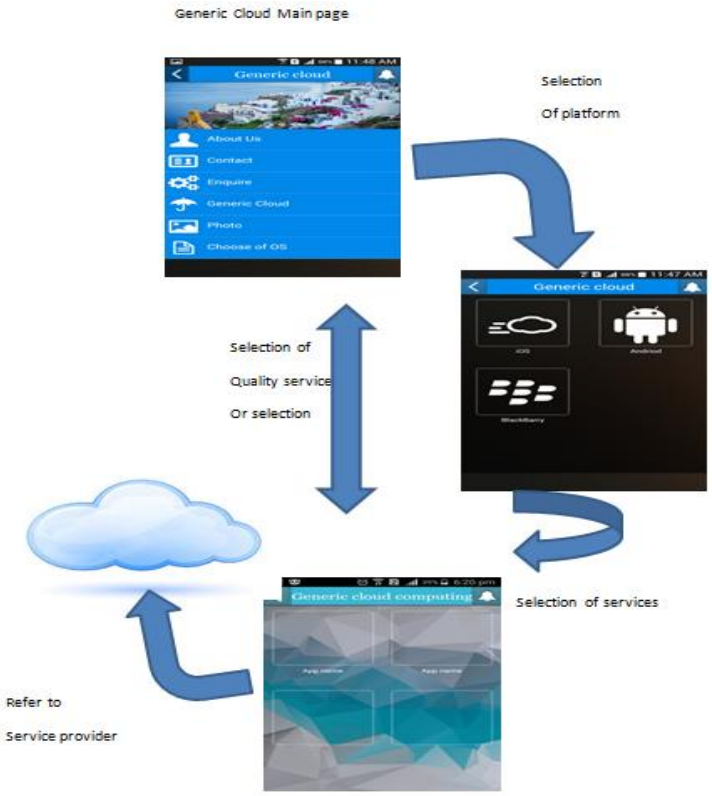

Fig. 6: Prototype model of generic cloud

cloud works as a load balancing between the services providers and mobile users.

Platform dependent services and application

The application and services which platform dependent likes (iOS, Android, BlackBerry) are developed accordingly the device manufacturer and support that specific device so, the user can access that services on the specified play store like for android Google app engine for iOS apple play store.

Virtualization component

If the device has less computing power or the requested service is not provided by that service provider, the request refer to the virtualized component of cloud which process the data and gives output to device. In this way a user can get all services, more computing power and application in MCC by the virtualizations component of cloud.

Application services and data management

Application is dividing among the devices and user can use that application accordingly their device specification. User enhances the services and pays accordingly their use. Data management use for manage of devices in cloud and billing accordingly the used services. As services are divides among the layer approach between devices we can monitor the devices and services in MCC.

MCC Statistics

We have all statistics about users in MCC. All service providers can monitor and control the services and application with in MCC. We can see all devices and applications which are running and most popular or less visited services also can test any application in MCC. The mobile analytics tools for mobile website and apps like Google analytics, Countly and segment.io can be developed for MCC monitoring and control.

Scenarios

Our purposed system performs action between mobile devices and different mobile cloud service providers through the generic cloud. First request received by the generic handler then generic analyzer perform the analysis of device like platform, computing power, connection bandwidth, and requested services or application. Then its forward to the generic dashboard where the manager mange all the data about the mobile device, session handler create the session for device request and session profiler save the mobile device profile and assign the unique identifier for the request of device. Cashing module saves the original request from the mobile device for further response purpose. Then the generic request analyzer get the analysis report of request to following the cloud service register and quality of service in the index of other service provider module. Here the report and different scenarios comes in the report which is given as below.

Scenario 1:

If the requested application or service match to the cloud service register and QOS insure that the service is available and according to the device then request will be send to scheduler for perform the task.

Scenario 2:

If the requested application or service does not available in the list of register services and application then session profiler destroy the session and response to the mobile device.

Scenario 3:

If the requested application is platform dependent then it's refer to the specific platform and request resolve through that service provider,

Scenario 4:

If the requested application is not platform dependent then the request deliver to the generic scheduler which maintain load balancing policy and schedule the job for different service provider cloud.

Scenario 5:

If the requested application wants the more computing power and device not supports that processing power then the request module send the request for virtualized computing resources and after the computing through generic scheduler the response is given by generic response module to the device.

Scenario 6:

When request received then according to the generic request analyzer report the request generic module convert the request to the form REST, SOAP or JSON which is supported by the mobile service provider.

Scenario 7:

The cross platform services response is converted to the REST WS by the generic response module before sending response to mobile device because the mobile devices are supporting REST in the HTTP protocol response.

IV. Prototype Model for MCC Architecture

As we discussed before the generic cloud of MCC gives the services to the users. It provides the services accordingly the device specification and in layered approach of service providers. When a user connects then the generic cloud first analyze the device and authenticate the device specifications including device operating system, computing power, connection bandwidth.

User Stack

After analysis report of the device the user selects the service which is in layered form within the index of generic cloud. After the selection of service the generic cloud checks and verifies the availability and possibility of following conditions.

The requested service is available.

The device fulfills the requirements of enhancing that service.

The connection bandwidth is enough for enhance that service.

The service provider is enabling for providing quality of service to user.

If the requested service required more computing power then it will be refer to the virtualization component of cloud to resolve the request.

After the analyses the request is refer to the service providers for enhancing the best user experience with in MCC.

Generic cloud management

Generic cloud has indexing of other service provider clouds. It contains the list of all service provider clouds. The generic cloud checks availability and verify the services of other clouds. It's maintained and updates the lists of application and services in generic cloud.

The connecting and selecting process of services within generic cloud is shown in Fig. 6. Experimental prototype model uses for the access time of service in MCC. Table 1 shows the access time of application including Gmail, GPS, Face book, online gaming with middleware and without middleware. Also table shows the minimum possibilities occur in error during access the applications and services.

Table 1: Response Time for Accessing the Services in MCC

	Middleware (s)	No Middleware (s)
Request the Gmail services	30	60
Request the GPS services	40	70
Request the Facebook services	25	50
Request the music services	20	35
Request the Online Snooker services	50	80

Fig. 7 presents a reference diagram appearing and figuring the time it takes to a customer to ask for a cloud service (from the asking for it to getting the required service) under various service providers. For each of these services, we register and compute the response time with and without using the middleware.

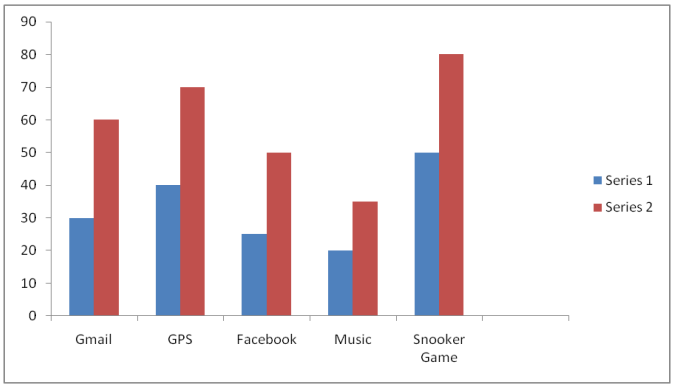

Fig. 7: Graph of access response time

V. Comparison of Traditional and Proposed MCC Architecture

As we discuss before mobile devices has its own limitations and mobile cloud mitigate these mobile limitations and provide the power of cloud to mobile. The proposed MCC

Table 2: Comparison of mobile device, Traditional and Proposed Architecture

Disadvantages of Mobile Equipment	Limitation of traditional MCC Architecture	Proposed MCC Architecture
Bandwidth limitations.	No calculation of bandwidth.	Calculation of bandwidth.
Limited resources.	Open access to resources in MCC	Access to resources in mcc according to device specifications.
Limited calculation capability.	More CPU capacity.	More CPU capacity.
Poor battery timing.	Save battery time intelligent balanced load.	Efficient battery storage on mcc.
No application testing.	No option to test mobile application.	Test mobile application on MCC.
More data delivery time.	More data delivery time.	Reduced data delivery time.
Limited storage capacity.	More storage capacity.	Efficient storage capacity.
Platform dependent.	Platform dependent.	Platform Independent.
Limited services.	Security and services lack.	Security of services.
Limited communication power.	Communication gap.	Quality of communication.
Limited option for services.	No option for monitor and control of services and application.	Monitor and control of services and applications.

architecture provides many features of cloud to mobile user which is not introduced before it. A comparison of mobile devices, traditional MCC architecture and proposed architecture is given in Table 2.

VI. Discussion

Division of application and services

The main advantage of proposed architecture is division of application. By division of application we achieve accuracy in applications and services within MCC. User faces no more services error like before and quality of services achieves due to application division between mobile specification and bandwidth.

Consideration of bandwidth and device specification

In proposed architecture due to consideration of bandwidth user aware with the application and services which are suitable to their bandwidth and device specification. User only can select those services which are accordingly their device specification and user no more suffer for the denial of services, application services or quality of communication error with in MCC.

Quality of communication

The proposed architecture mitigates the communication gap between user devices and mobile cloud. Because the application and services are provides considering the user devices specification and their bandwidth so the communication gap is mitigate by this way in MCC.

Monitor the devices/users/services in MCC

We can monitor the devices/users/services in the mobile cloud due to distribution of services among the users. The services and application are in layered approach for users in MCC. So we can monitor devices, services and users easily in MCC.

Testing usability and quality of services

For testing perspective the proposed architecture can test the application usability and services quality with in MCC. By the usage of new services and application by user with in MCC we can rate and modify any application and service within MCC and can test the application in MCC which are more rated and popular applications and services.

Reduce data delivery time

The proposed architecture as design to considering the devices bandwidth and communication power so the data delivery time is reduced and managed by MCC accordingly the design architecture.

Location and platform independence services

The proposed architecture is platform independence and the devices are not location based user can use MCC services and application at any device, anytime and anywhere.

Security of services and application

The proposed architecture is based on distribution layered approach in application and services within MCC. The user can only use those services which are exist in their layer and can access those services which are accordingly their device and other services and application are not available for that devices, in this way the services and application are not open access for other devices.

VII. Conclusion And Future Work

In this paper, we have mitigated challenges surrounding MCC architecture. We focus three main problems in MCC architecture which are limitation of mobile devices, quality of communication and division of application. By our proposed architecture user can enhance the availability of services, more computing power and more available services and application due to virtualization component of services provider. MCC service provider can enhance quality of services, load balancing, availability and security of services, extension of layers and services and more computing power through virtualization. Mobile cloud computing have a wide era of exploration of new component and technology to exploit revolution of mobile devices. In our future research work we will proceed with network independency and sub layers of services and applications for all kind of users in MCC.

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