CHAPTER 3: MOBILE CLOUD COMPUTING: MCC ARCHITECTURE

Mobile computing is a generic term which is used reference to a large variety of devices which allow the users in accessing the data & information from anywhere at any location. Mobile cloud computing is the integration of 2+1 technology termed as the mobile computing, cloud computing & the mobile internet. The drawback of mobile computing is the connection loss, lesser availability of bandwidth & limited resources. This paper overcomes these limitations & focuses on the proposed architecture for the mobile clients using the middleware which is called as the cloud computing. This middleware provides additional benefit of service mashup as well as the protocol transformation.

3.1 Introduction

Everyone engaged in the IT world is talking about the real importance & its impact on the business organization. Cloud is beneficial as the principle “Pay as- you go manner” is followed. The main advantage of Cloud computing is the flexibility which makes it distinguishable from other computing technologies such as Grid/Utility computing as well as SAAS (Software as a Service) (Mathur P (2010)). Cloud computing platforms are growing at a very rapid rate, & the IT sector is planning to move into the modern era in order to save the cost, time as well as other expenses. Cloud computing is an advanced technology over the distributed computing. The huge computing problems can be solved out by partitioning into parts the small parts are distributed such they they can be able to deal with the typical computer resources. The results are combined together to obtain the final results. Another computing technique called as distributed computing is also able to work very efficiently like the super computer & cloud comprises main part of cloud computation which is responsible for the entire computing task. Cloud is a bunch of computers located at different physical locations and a medium that provides networking resources to the clients. It focuses on all the computing resources together to manage very effectively with the software system thereby lessen up the optimization & cost of the resources. (Mayon L M. Peixato et al (2009)).

3.2 Computation using mobile computing
It is referred to as the interaction between humans & computers where in the computer seems to be transported during the normal usage. It also has the involvement of various mobile technologies including communication of mobile, mobile hardware, and mobile software & the issues including ad-hoc and infrastructure networks. As the mobile network infrastructure is continuously improving, their data transmission is also becoming easily available at an affordable price hence they are becoming the popular clients for consuming the web services. The mobile devices have also included various applications in which web access is allowed from over the internet web services such as Google Play, Facebook, and Twitter etc. While a problem is still there in connecting mobile devices with an existing web services due to below discussed reasons:

- Mobile devices have limited resources such as CPU power, screen size, memory, and durability.
- The communication between client and service is also established through wireless or cell network.
- The mobile clients are also not supported in the recent cloud web service network.
- During non-availability of power generator mobile computers must depend fully on battery power as the large scale expensive batteries are used herein.

These limitations can be overcome by means of cloud computing integrated with the mobile computing technology hence the name termed as Mobile Cloud Computing comes into the picture. MCC is a combination of 2+1 technology including the computation of mobile computing, internet of mobile & cloud computation. Mobile computing technology (Mathur P (2010)) implies resource sharing & data transportation of computers or various important & intelligent devices such as cell phones. The Figure 3.1 shows the web services consumption using the mobile client. Its importance lies in the fact that a real time, valuable & precise information is provided to the end users and the clients at a specific period of time. The ability of CPU processing, storage structure, keyboard, screen, battery and bandwidth when compared with PC seems to be very powerful according to the mobile platform.

“An interoperable machine-to-machine interaction over a network is provided by the software system designed for the same. Its interface has been described in a machine-process
able format (e.g. WSDL) (Mathur P (2010))). While the other systems always try in interacting along with the web service in a prescribed manner in the form of using messages (Bonomi F (1990)) & is typically distributed by using the protocols such as HTTP serializing the XML in contrast to the other Web-related standards & procedures.”

Figure 3.1: Web Services Consumption using Mobile Client

The challenges while consuming web services from mobile clients are as follows:

3.2.1 Connection break up: A stable connection is required between the client & service provider for the interacting properly & make use of services. But the mobility of the clients and the wireless network setup of the mobile clients can be removed temporarily from the previous connected network and then entering into another network.(Srinivasan S, Kettimuthu R et Al (2002)).

3.2.2 Bandwidth/Latency: It has always seen that the mobile networks have very limited bandwidth and are often charged on the basis of the data consumed by the client.

3.2.3 Limited resources: Mobile clients are called as the thin clients (Turkistany M, Helal A et Al (2009)) with very limited processing power. (Satyanarnynnan M (1993)). A service mash up involves parsing and combination of different web services & the results require too much computation. The challenges minimize the data processing on mobile clients and extend by processing power beyond mobile clients.
3.3 MCC Middleware Architecture

The various challenges as discussed above can be overcome by the architecture that has been proposed here in this section for the mobile cloud computing to interact the mobile devices with the cloud computation. The MCC also includes the architecture of both the mobile client and a middleware design.

![Diagram: Web Services Consumption using Mobile Client with proxy](image)

**Figure 3.2: Web Services Consumption using Mobile Client with proxy**

The middleware in Figure 3.2 acts as a proxy that is hosted on the Cloud platforms which provides mobile clients access to the Cloud services thereby improving the interaction between mobile clients and Cloud Services such as cashing, optimizing etc. In order to overcome the challenges listed in the previous section, the MCC architecture is helpful in providing various features & functionalities (C Canfeng (2008)).

3.4 Connection loss
3.4.1 Caching of Client and middleware: The services enable the results to be stored on the mobile clients as well as the architecture of middleware is also provided. If there is some interruption to mobile clients while connecting to the middleware so the client-side cache is used thereon to solve the purpose & when the middleware to web services connection is not available the middleware returns its cached data to the mobile clients.

3.4.2 Middleware push: When an update is received by the middleware result of service it immediately sends the update to mobile clients that are connected to the middleware.

3.4.3 Bandwidth/Latency

Result optimization: Result optimization is the means to reduce the size of the service results to reduce the bandwidth used to interact with web services. The middleware architecture converts the format of service results from XML to JSON and removes unwanted data from the original service. The data transfer in lesser amount also helps in the reduction of the network latency.

3.4.4 Limited resources

The connection between the mobile clients with the cloud service provider helps in extending of the resources of mobile clients in a cost-efficient way. The services of cloud also helps in extending the functionalities of mobile clients while the cloud platforms provide better & cost efficient computational power to mobile clients. The middleware is designed in such a way so that it can be hosted on cloud platforms like GAE and Amazon EC2. Scalability is the top concern of the middleware. Cloud platforms provide automatic scaling for the middleware.

3.4.5 Personal Mash up Platform: Service mash up allows the mobile client to combine different services in one form. The service mash up requires the interaction with the web services as well as it also taken care of the processing power but due to the limited resources of mobile clients it is quite difficult to do service mash up with this. The middleware has provided a unique mash up platform for mobile clients which are used for service mash up. The platform used herein has the generic interfaces for defining and consuming the web services which are often stored on the middleware and can be connected to form a work flow which provides possibility to cache intermediate service results. Middleware is often used in a distributed Computing (DC)
system (Emmerich W (2000)) which consists of multiple autonomous processors where the primary memory is not shared but cooperated by sending messages over a communications network.

3.4.6 Network communication: Figure 3.3 denotes the responsibilities of the middleware architecture such as service mash up, cloud computing operation & transformation of various protocols.

![Figure 3.3: Responsibilities of middleware](image)

The following steps are involved while working through the presence of middleware.

- The HTTP GET request is sent by the mobile client with an identifier of a web service to the middleware architecture.
- The role of middleware lies in interacting with the web service and also helps in generating the SOAP web service client if there is a need.
- The middleware also deals in extracting the JSON or XML parsing the required service results from the original service result and form a new service results in the JSON format.
The middleware also stores a result copy including the service ID in the database and returns the optimized result to the mobile client.

3.5 Conclusion

We have proposed the architecture for mobile thin clients having the middleware treating as a proxy server thereby allowing mobile data & service creation, management & sharing across mobile clients. The architecture can be evaluated on the cloud infrastructure test bed. Cloud computing is the emerging technology in the today’s era and will prove to be a very efficient technology. Combining it with the mobile computing may change the whole scenario as we saw in this study above. Mobile computing itself is not as much efficient as it lacks bandwidth availability as well as connection is not stable & unavailability of physical resources.