Mobile Cloud Computing: A Tool for Future

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Abstract— **in this paper, we are presented Introduction, future scope, and advantages of mobile cloud computing. Mobile cloud computing is a universal term for anything that involves delivering hosted any kind of services which includes cloud computing as a middleware, like as mobile-healthcare, mobile-learning, mobile-entertainment, etc. over the Internet. Mobile cloud computing is the usage of cloud computing in combination with mobile devices or mobility hardware. Mobile cloud computing succeeds when data storage and data processing are kept on the internet (cloud computing) base rather than on individual devices (mobile devices), and also provides on-demand (anytime, anywhere) access.**

Keywords- **Mobile cloud computing (MCC); mobile network; cloud computing; web services; mash up platform; cloud services**

I. INTRODUCTION

Cloud computing is a term for technologies that providing computation power, software, data access, and storage services that do not require end-users knowledge of the physical locations and configurations of the system that delivers the services. Cloud Services refers to software functions exposed as WS on the Internet, also called Web API. For e.g., some services that provides information about the closest city based on geo co-ordinates. In this paper we have proposes a "Mobile Cloud Computing" architecture which uses Cloud-hosted middleware to support mobile clients consuming Web Services (Cloud Services). The architecture enhances the interaction between mobile clients and Web Services and provides a personal service mash up platform for mobile clients.

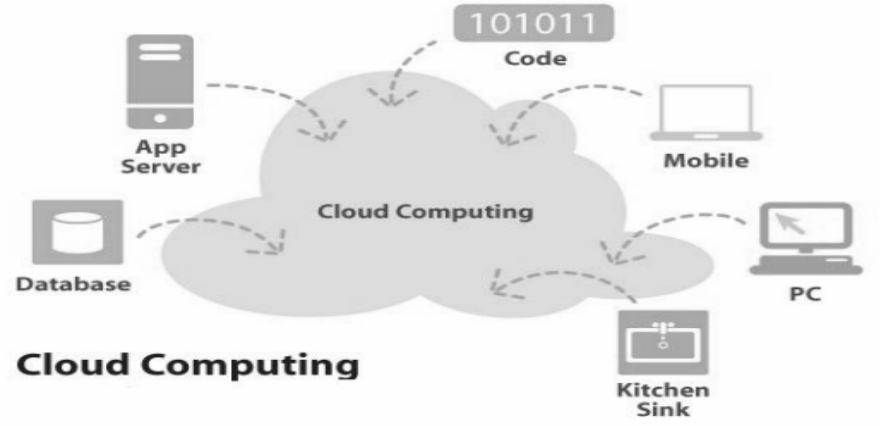

Figure 1.1: Cloud computing with various components

II. DESCRIPTION

Way of application before mobile cloud computing: Traditional business systems have always been very complexity and expensive. The amount and variety of h/w and s/w required to run them are intimidating. You as

company need a whole team of experts to installation, configuration, testing, and running, secured, and update them as well. When you are going to multiply this effort across hundreds or dozens of applications, it's easy to realize why the giant companies with the best Information Technology departments aren't getting the applications or services they necessity. Small scale and mid-sized businesses do not stand a chance.

Mobile-Cloud-Computing, A better way: With MCC, you eradicate those worries because you aren't managing h/w and s/w, that's the responsibility of cloud vendors like sales force, amazon. The sharing basis infra-structure means it working like as service: You only pay for what you use, need, and updates are automatic and mounting up or down is easy.

III. MOBILE CLOUD COMPUTING

The MCC forum defines MCC as follows [3]: "Mobile cloud computing at its simplest refers to an infrastructure where both the data storage and data processing happen outside of the mobility devices (e.g., tablet PC, smart-phone). Mobile cloud apps move the computing power and data storage capacity away from mobile phones and into the cloud power, bringing applications and MC to not just smartphone users but a much broader range of mobile subscribers".

Mobile cloud computing is the usage of cloud computing in combination with mobile devices. Applications are run on a remote server's and then response sending to the users. Because of the advance improvements in mobile browsers thanks to the companies like Microsoft, Apple and Google over the past couple of ages, nearly every mobile device should have a suitable browser application. This means developers will have a much wider market as before, means they can be avoid the constraints created by mobile kernels or mobile operating systems. MCC gives new company chances for mobile network providers/companies. Several operators like as, Orange, Vodafone and Verizon have started to offer cloud computing services for respective companies. Ali-baba Group launched cloud computing-based operating system "Aliyun" on 29th July, 2011. The "Aliyun" operating system will features cloud services such as content searching, e-mail and supports for web-based application/s. Users aren't required to download or install applications onto their mobile devices or hardware.

A. Definition

Mobile cloud computing (MCC) is a combination between mobile networks & cloud-computing services, thereby providing optimum services for mobile end-users. In mcc, mobile devices do not need a powerful configuration's such as (e.g., Memory capacity, and CPU speed) since all the data/information and complicated computing modules can be processed into the clouds.

B. Application

Mobile applications usages are a rapidly emerging division of the globally mobile markets. They consist of Software's that running on mobile devices and performs a certain tasks for the users of the mobile phone/device. As reported by World Mobile Applications Market, about 7 billion (free and paid) application downloads were made globally in 2009 alone from both native and 3rd-party application stores, generating revenues of $3.9 billion in the equal year. The global mobile application market is, expected to be worth $24.4 billion in 2015, growing at a CAGR of 64% from 2009-to-2015. Apple is a typical example for the flare-up of mobile applications. Apple with an enormous more than 4 billion downloads to date commanded more than 90% of the application market share in 2009 year. The success of Apple's App Store has not only established the scalability of mobile application's, but has also shown that the best of these offer the potential to generating vast profits.

III.B.1 Mobile Commerce

The bang in the use of electronic commerce (e-commerce) by the business sector has been incredible since its commencement only a few years ago. E-commerce is known as: buying and selling of products or services over electronic systems such as other computer networks and the Internet. From, governments to multi-national companies to 1-person start-ups, e-commerce is increasingly viewed as a key business modality of the future aspect. Wide markets (across the countries as well), Ease of transaction, and de-creased overheads are some aspects that make e-commerce solutions much more attractive, as apparent with the growing of on-line sales.

III.B.2 Mobile Learning

Mobile learning, now-a-days is becomes more popular as there are many peoples using mobile devices to Enhance their learning through the use of mobility. Mobile learning (m-learning) is not only electronic learning (e-learning) but e-learning with plus point as mobility. It is vibrant idea that learning via mobile brings many benefits for mobile users. It brings the accessibility for them since they can learn anywhere they want in any convenient time from a portable/mobile device. However, there are some researches pointed out restrictions of traditional mobile learning such as: high cost of network access, expensive mobile devices, poor network transmission rates, and limited educational resources. As a result of that, it is tough for mobile learning (m-learning) to take its own advantages and to be popular as well.

III.B.3 Mobile Healthcare

The growth of telecommunication technology in the medical field helped diagnosis and treatment become easier for various peoples. This can helps patients regularly monitor their health and have timely treatment as well. Also, it leads to increase accessibility to health-care providers, more and more efficient tasks and processes,

and the development about qualities of the healthcare services. Never-the-less it also has to face many challenges (e.g., medical errors, physical storage issues, security and privacy. Therefore cloud computing is introduced as a solution to address above-mentioned issues. Cloud computing provides the handiness for users to help them access resources quickly and easily. Besides that, it offers services on-demand over the network to perform operations that meet changing needs in electronic healthcare or mobile healthcare application.

III.B.4 Mobile Entertainment

The study and analysis of the impact of mobile computing on the various services shows how the mobile computing has changed each service's and has given a new alter to them to get a good future forthcoming to develop a good method for each services. As mobile computing has become more popular over the past decade, it has been under continuous developments with advances in hardware, software and network. The mobile computing has various applications in our everyday life. This technology has become a central skill. With, mobile computing we can check our e-mail messages, our different kinds of bills, our bank accounts and our other private information's, just by using a mobile phone or laptop anywhere, and any convenient time. All the functionalities oblige each exchange data to make it safe and immune from any kind of attack. Mobile computing services have not only simplified our lives but also provide some meaningful applications; by using of those mobile applications we can enrich our life as compare to old time. Every day we get attached to a new device that includes a lot of functionalities and is based on mobile computing, as examples, Android Smart-phones, I-Phone from Apple, Black-Berry, Net-Book, etc.

III.B.5 other useful applications

A cloud computing services becomes a useful tool to help mobile clients to share videos and photos efficiently and tag their friend in popular social networks as Facebook (FB) and Twitter. MeLog [4] is an MCC application that enables mobile clients to share real-time experience (e.g., travelling, shopping, and events) over cloud services through an automatic blogging. The mobile clients (e.g., travellers) are supported by several cloud services such as guiding their trip, showing maps, recording route, and storing images and video clips as well.

IV. PROBLEM DEFINITION

A. Consuming web services from mobile clients

Consuming WS from a mobile client (see figure 3.1) is different compared to the standard WS scenarios, due to the following factors.

- Mobile devices have limited resources (e.g. CPU power, screen size).
- The communications between the client and services is established through wire-less or cellular network.
- Existing W.S. in the Cloud do not support mobile clients.

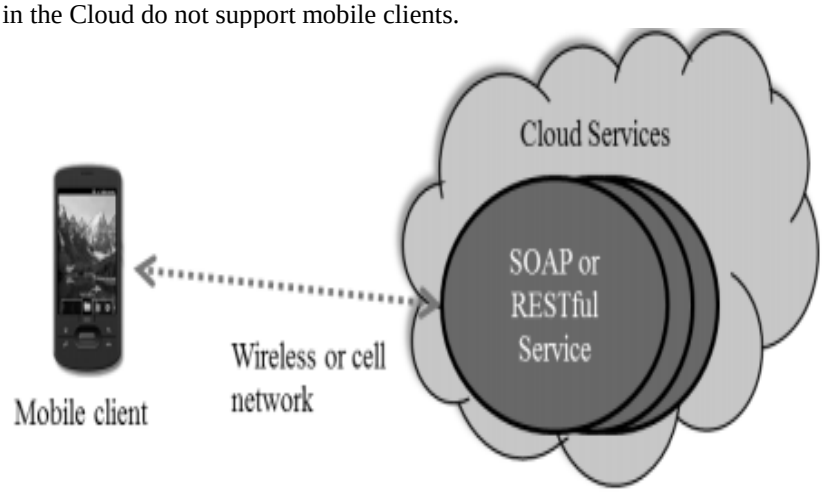

Figure 3.1: Consuming WS from Mobile Client

There are several challenges in the process of consuming Web Services (WS) from mobile clients. The Following some are the focuses of this paper.

Challenge 1. Loss of connection: The interaction between clients and service requires a steady connection. However, due to the mobility of the clients and the wireless network setup, mobile clients can be temporarily removed from the previous connected network and later may enter to another network. In such occurrences, either service requests or responses may fail to be delivered to their destination.

Challenge 2. Bandwidth/Latency: Cell networks have limited bandwidth and are often billed based on the amount of data transferred. However, even a simple SOAP message often contains a large amount of XML data/information, which consumes a lots of bandwidth and the transmission can cause major network-

latency. In addition, the S.O.A.P. messages contain mostly XML tags that are not all necessary for the mobile clients.

Challenge 3. Limited resources: Mobile clients are "thin clients" with limited processing power. The boundaries are essential to mobility and not just the failings of current technology. For example, a service mash up involves parsing and combining different WS results requires a lot of computation. The challenges are minimizing the data processing on mobile clients and extending processing power beyond mobile clients. In addition, several mobile platforms do not include necessary libraries for S.O.A.P. Web Services.

V. THE IDEA OF MOBILE CLOUD COMPUTING (MCC)

As what is mobile cloud computing and applications that are use of mobile cloud computing concept. Here to overcome these above challenges, We plan a Mobile Cloud Computing (MCC) architecture (see figure 4.1) which connects mobile devices to the Cloud Computing services. The MCC design includes a mobile clients and a middle-ware design.

There are two approaches to implement the mobile client: native applications and embedded browser applications. Native applications are built within specific programming languages which were supported by the mobile platforms. How-ever, embedded browser applications can run HTML and Java Script in the embedded browser and use interfaces exposed by native application.

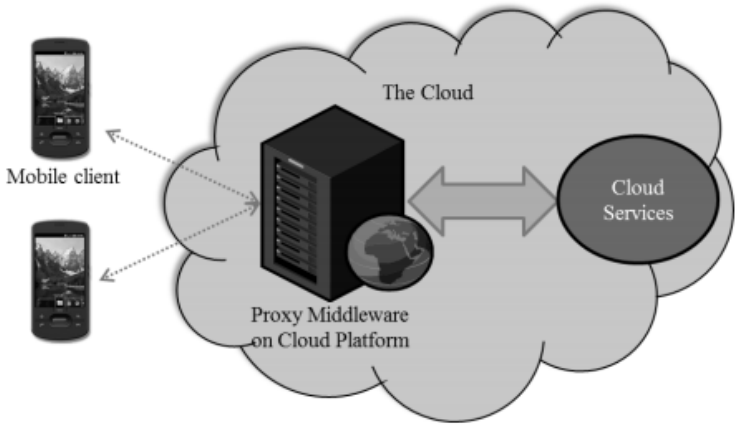

Figure 4.1: Consuming WS from Mobile Client through Proxy Middleware

The middle ware acts as a proxy that is hosted on the Cloud platforms which provide mobile clients access to particular Cloud services. The middle ware improves interaction between mobile clients and Cloud Services, for example, adaptation, caching and optimization. The middle ware also provides extended utilities to mobile clients, such as service mash up. In general term, the middleware enhances the functionality, compatibility and reliability of the interaction between mobile clients and Cloud Services model. In order to overcome the encounters listed in the previous section, the Mobile Cloud Computing (MCC) architecture provides the following features.

(1) Connection loss

- Client and middleware caching – Copies of service results are stored on both mobile clients and the middle ware. When the mobile clients are not able to connect to the middleware, the client-side cache is used. When the middle ware to W.S. connection is not available, the middle ware returns its cached data to the mobile clients.
- Middleware push – When the middleware receives an update of service result, it immediately sends the update to mobile clients that are connected to the middleware. When the mobile clients detect an available network connection, they automatically establish a connection to the middleware.

(2) Latency/Bandwidth

- Protocol transformation – Protocol transformation reduces the latency as well as bandwidth of the client to service interaction. The middleware transforms SOAP WS to Restful WS. SOAP is a verbose protocol which involves XML parsing, while Restful WS can use light-weight format like JSON for the message. Transferring SOAP WS to light weight-protocols, such as Restful W.S., reduces processing time as well as the size of the messages in a way as it is.
- Result optimization – Result optimization reduces the size of the service results, thus reduces the bandwidth used to interact with WS. The middleware converts the format of service results from XML (extensible Markup Language) to JSON (JavaScript Object Notation) and removes

unnecessary data from the original service result. Less data transferring to mobile clients is also reduces network -latency.

(3) Limited resources

- Cloud Computing – Connecting mobile clients to Cloud Computing extends the resources of mobile clients in a cost-efficient manner. Cloud Service's extends the functionalities of mobile clients, while Cloud Platforms provides computational power (software and hardware resources) to mobile clients. The middle ware is designed to be hosted on Cloud platforms, like G.A.E. And Amazon EC2. Scalability is the top concern of the middleware. Cloud platform models provide automatic scaling for the middleware.
- Personal Mash up Platform – Service mash up allow mobile client to combine different services. However, service mash up requires interaction with WS and processing power. Because of the resources limitation (energy, processing power, software libraries) of mobile clients, it is inefficient to do service mash up on the mobile clients. The middleware provides a Personal Mash up Platform which does service mash up for the mobile devices/clients. The platform has basic interfaces for define and consume W.S. The services are stored on the middle ware and can be connected to form a work flow (a mash up service) which provides possibility to caching intermediate service results.

VI. ADVANTAGES OF MCC

Cloud computing model is known to be an encouraging solution for Mobile Computing because of many reasons (such as, portability, communication, and mobility [5]). In the following, we describe how the cloud services can be used to overcome hindrances in M.C., thereby pointing out advantages of MCC.

(1) *Improving processing power and data storage capacity:* storage capacity is also a one of the main constraint for mobile devices; MCC is developed to enable mobile clients to access or store the large amount of data on the cloud through wire-less networks. First example is the Amazon S3 (Simple Storage Service) [6] which supports file storage service. Another example is Image Exchange which utilizes the large storage space in clouds for mobile clients [7]. This mobile photo sharing service enables mobile clients to upload images to the clouds immediately after capturing. Mobile users may access all images from any devices. With the cloud, the clients can save considerable amount of energy and storage space on their mobile devices because all images are sent and processed on the cloud side. Flicker [8] and ShoZu [9] is also the successful mobile photo sharing applications based on MCC. Facebook [10] is the most successful social network application today, and it is also a typical example of using cloud in sharing images.

Mobile cloud computing also helps in reducing the running cost for compute-intensive applications that take long time and large amount of energy when performed on the limited-resource devices. C.C. can efficiently support various tasks for data ware housing, managing and synchronizing multiple documents online. For example, clouds can be used for transcoding [11], playing chess [12, 13], or broadcasting multimedia services [14] to mobile devices. In these things, all the complex calculations for transcoding or offering an optimal chess move that take a long time when perform on mobile devices will be processed efficiently on the cloud. Mobile applications also are not constrained by storage capacity on the devices because their data now is stored on the cloud.

(2) *Improving reliability:* Storing data/information's or running applications on clouds is an effective way to improve the reliability because the data and application are stored and back-up on a number of computer systems. This one reduces the chance of data and application lost on the mobility devices. In addition, M.C.C. can be designed as a comprehensive data security model for both service providers and mobile clients. For example, the cloud can be used to protect copyrighted digital contents (e.g., video-clip, and music) from being abused and unauthorized distribution [15]. Also, the cloud can remotely provide to mobile clients with security services such as virus scanning, authentication and malicious code detection, [16]. Also, such cloud-based security services can make efficient use of the collected record from different users to improve the effectiveness of the services.

(3) *Extending battery life-time:* Mobile devices battery is one of the main concerns for mobile devices. Numerous solutions have been proposed to enhance the CPU performance [17, 18] and to manage the disk and screen in an intelligent manner [19, 20] to reduce power consumption. However, these solutions require changes in the structure of mobile devices, or they require a new h/w that results in an increase of cost and may not be feasible for all mobile devices. Computation off-loading technique is proposed with the objective to migrate the large computations and complex processing from resource-limited devices (i.e., mobile devices) to resourceful machines (i.e., servers in clouds). This avoids taking a long application execution time on mobile devices which results in large amount of power consumption. Rudenkoet al. [21] and Smailagic and Ettus[22] evaluate the effectiveness of offloading techniques through several experiments. The results demonstrate that the remote application execution can save

energy significantly. Especially, Rudenko et al. [21] evaluates large-scale numerical computations and shows that up to 45% of energy consumption can be reduced for large matrix calculation. In addition, many mobile applications take advantages from task migration and remote processing. For example, offloading a compiler optimization for image processing [23] can reduce 41% for energy consumption of a mobile device. Also, using memory arithmetic unit and interface (MAUI) to migrate mobile game components [24] to servers in the cloud can save 27% of energy consumption for computer games and 45% for the chess game.

(4) *Dynamic provisioning*: Dynamic on-demand provisioning of resources on a fine-grained, self-service basis is a flexible way for service providers and mobile users to run their applications without advanced reservation of resources.

(5) *Scalability:* The deployment of mobile applications can be performed and scaled to meet the unpredictable user demands due to flexible resource provisioning. Service-providers can easily add and expand an application and service without or with little constraint on the resource usage.

(6) *Multi-tenancy:* Service providers (e.g., network operator and data center owner) can share the resources and costs to support a variety of applications and large number of users.

(7) *Easy Integration:* Multiple services from different service providers can be integrated easily through the cloud and Internet to meet the user demand.

VII. CONCLUSION

Mobile technology continues to grow, which makes it easier to consume WS from mobile devices. Personalized service mash up is also required by mobile devices/clients. However, mobile devices are still considered constrained devices compared to stationary computers cause of some limitations and advantages also. When developing a mobile WS client, developers and service providers need to consider the heterogeneity of mobile platforms.

In summary, the current paper indicates:

- It is possible for mobile clients to consume WS.
- Adaptation is needed for mobile clients to interact with WS.
- Middleware can extend the functionalities of mobile clients.
- Cloud Platforms are cost-efficient, scalable and reliable for hosting middleware.
- Service mash up is light-weighted WS composition and can be designed on server side.

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