# Mobile-Cloud: A Framework of Cloud Computing for Mobile Application

Jibitesh Mishra[1], Sanjit Kumar Dash[2], and Sweta Dash[3]

[1,2] Department of Information Technology
College of Engineering & Technology
Bhubaneswar, Odisha, India
[3] Synergy Institute of Engineering and Technology
Dhenkanal, Odisha, India
{mishrajibitesh,sanjitkumar303,swetadash123}@gmail.com

**Abstract.** The proliferation of mobile computing and cloud services is driving a revolutionary change in our information society. We are moving into the Ubiquitous Computing age in which a user utilizes, at the same time, several electronic platforms through which he can access all the required information whenever and wherever needed. The mobile devices provides the easiest solution for ubiquitous access through wireless network. Mobile users can use their cellular phone to check e-mail, browse internet; travelers with portable computers can surf the internet from airports, railway stations etc. The mobile capabilities can be integrated with cloud computing services to give more secure and advanced services to the subscribers. The emerging domain of Mobile-Cloud extends the Mobile Computing paradigm to the sharing of cloud resources in distributed computing environment. A Mobile-cloud is the result of the integration of mobile application with the cloud. In this paper we propose a Mobile Cloud Computing architecture to integrate mobile application with various cloud services. Our Paper aims at using cloud computing techniques for storage and processing of data on mobile devices, thereby reducing their limitations.

**Keywords:** Mobile Subscriber, Cloud Computing, Mobile Cloud Computing**,** micro browser.

## 1 Introduction

Cloud Computing means “Internet-based” development, where ‘Cloud’ is a metaphor for ‘Internet’ and ‘Computing’ meaning, the use of “Computer technology”. Cloud computing is clearly one of today’s most enticing technology areas due to its cost-efficiency and flexibility. But cloud computing’s potential doesn't begin and end with the personal computer's transformation into a thin client - the mobile platform is going to be heavily impacted by this technology as well. Cloud computing will dramatically reduce the requirement of advanced handsets for running mobile applications, according to the study. According to the latest study from Juniper Research, the market for cloud-based mobile applications will grow 88% from 2009 to 2014.

N. Meghanathan et al. (Eds.): CCSIT 2012, Part III, LNICST 86, pp. 347–356, 2012.

The market was just over $400 million this past year, says Juniper, but by 2014 it will reach $9.5 billion [1]. In Mobile Cloud Computing both the data storage and the data processing happen outside of the mobile device i.e. when we combined concept of cloud computing in mobile environment, all the computing power and data storage move into the mobile cloud.

The rest of this paper is organized as follows. Section 2 gives an overview of Cloud Computing, Section 3 gives the architecture of Mobile Cloud Computing, Section 4 outlines the working of mobile cloud computing, Section 5 describes an inspiring example "Google Sync" of mobile Cloud Computing, Section 6 discusses various services required by mobile client/server and Section 7 puts forth the Pros and Cons of Mobile Cloud Computing. Finally, Section 8 concludes the paper.

## 2 Cloud Computing

According to National Institute of Standards and Technology, USA (NIST) Definition of Cloud Computing is[2] :

*Definition: Cloud computing is a model for enabling ubiquitous, convenient, on demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.*

Cloud computing encompasses a whole range of services can be hosted in a variety of manners, depending on the nature of the service involved and the data/security needs of the mobile subscribers. However, the basic idea behind the cloud model is that anything that could be done in computing from storing data to collaborating on documents or crunching numbers on large data sets can be shifted to the cloud. Certainly, cloud computing enables a new platform and location-independent perspective on how we communicate, collaborate and work So long as you can access the Web, you are able to work when and where you wish. With fast, reliable Internet connectivity , it does not matter where the document, the e-mail or the data the user sees on the screen comes from. With cloud computing for mobile phone user will get benefit in number of ways and help them to ran there business application without large amount of capital investment in infrastructure and services.

For individuals, cloud computing means accessing web-based email, photo sharing and productivity software, much of it for free [3]. For organizations, shifting to the cloud means having the ability to contract for computing services on-demand, rather than having to invest to host all the necessary hardware, software and support personnel necessary to provide a given level of services [4]. And for governments, the value proposition of the cloud is especially appealing, given both changing demands for IT and challenging economic conditions [5]. The delivery model of cloud computing for mobile applications are given below


**Fig. 1.** Cloud Service Architecture

### A. Software as a Service (SaaS)

In this model an application is hosted as a service to customer who accesses it via the Internet [6]. With SaaS the subscriber doesn't own the software, or even have to execute the code, he/she simply pay as he/she uses the software which is hosted elsewhere. For example mobile user can use Google doc and they do not need to install any application for that. Other providers like Amazon provides cloud services and subscriber need to pay only for the amount of services they want to use. Google Apps is also one of the examples which is provided by the service provider to the subscribers as a service. Google Apps aims to provide users with seamless, more secure access to information regardless of location or device. Google Apps supports access to Gmail, Google Calendar, Docs, and Contacts from most common types of mobile devices.

### B. Platform as a Service (PaaS)

PaaS services include application design, development, testing, deployment and hosting [6]. In this not only services but server, memory and other platforms can be used and subscriber needs to pay as per terms and conditions. The combination of software and infrastructure services with application development tools so that Web applications and services can be built and hosted. Examples include Google AppEngine and Salesforce.com's AppExchange.

### C. Infrastructure-as-a-Service (IaaS)

IaaS is the delivery of computer infrastructure as a service. With Mobile Cloud Computing mobile phone user will get benefit in number of ways and help them to ran there business application without large amount of capital investment in infrastructure and services. The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components (e.g., host firewalls).

Network as a Service (NaaS) is a more recent term, originally used in the IT and cloud computing context but now being increasingly applied in the mobile world. The NaaS model is not entirely new for network operators since they have been providing mobile virtual network operator (MVNO) access to their network as a service on a pay per use basis. However, NaaS is really about opening the network to value added subscriber services, created by third party developers, and charging for the use of the service on a pay as you use basis.

## 3 Architecture for Mobile Cloud Computing

The architecture of mobile Cloud computing mainly consists of three layers

A. Presentation tier
B. Application tier
C. Database tier.

Presentation Tier is used for user interaction to the server and application tier consists of providing various business logic through different service providers. Database tier provides full database and mobile communication functionality. It allows a mobile user to initiate transactions from anywhere and anytime ad guarantees their consistency preserving execution. The Database tier also provide securities, device provisioning etc. The database present in this layer is used for proving backup to the users in case of any loss or damage.

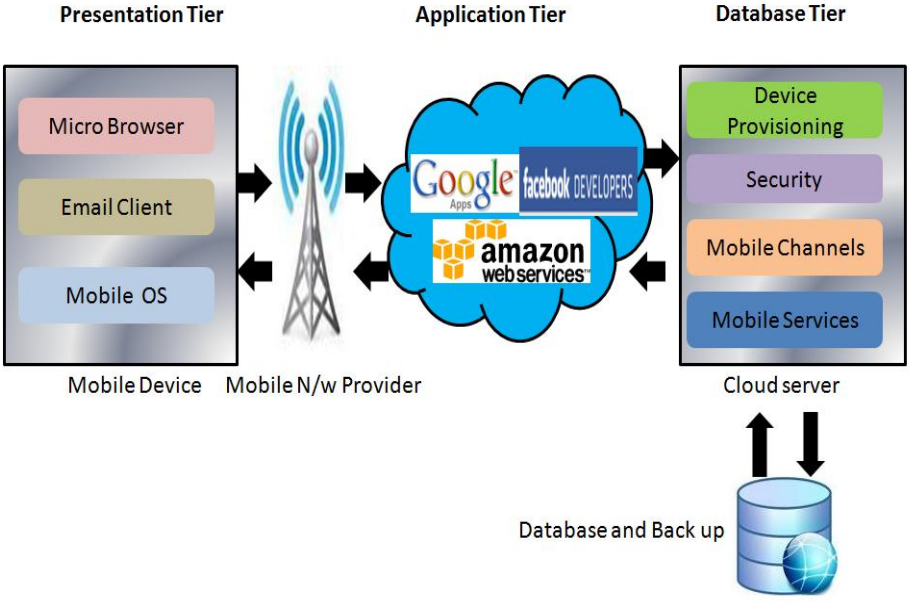


**Fig. 2.** Mobile Cloud Computing Architecture

### A. Presentation Tier

The presentation tier of mobile cloud computing architecture consist of the following components:

*Micro-browser:* A mobile browser, also called a micro-browser, mini-browser or wireless internet browser (WIB), is a web browser designed for use on a mobile device such as a mobile phone or PDA. Mobile browsers are optimized so as to display Web content most effectively for small screens on portable devices.

*Email Client:* This is an application which is specifically designed to access remote mail servers, retrieve mail from them, and manipulate that mail. Popular examples of these are Microsoft Outlook, Thunderbird, and Eudora.

*Mobile OS:* A Mobile operating system, also known as a Mobile OS, a Mobile platform, or a Handheld operating system, is the operating system that controls a mobile device—similar in principle to an operating system such as Linux or Windows that controls a desktop computer or laptop.

### B. Application Tier

Application Tier basically focuses on various services provided by a group of service providers . Some of the important cloud service providers are Google Apps, Amazon web services, Facebook developers , IBM, Windows azure etc.

### C. Database Tier

In Mobile Cloud Computing both the data storage and the data processing happen outside of the mobile device i.e. when we combined concept of cloud computing in mobile environment. In MCC scenario all the computing power and data storage move into the mobile cloud. MCC will not provide benefits only to the smart phone users but also help a broader range of mobile subscriber. Database not only stores subscribers data but also provides back up facility.

The cloud server is responsible for the following things:

*Device Provisioning:* Whenever a subscriber signs up for a broadband service, an initial process called device provisioning takes place, as the device used to access a service is “registered” by the provider. On reboot or during troubleshooting some or all of the device provisioning process may be repeated. Three of the most popular technologies used for device provisioning are Session Initiation Protocol(SIP), PacketCable and DOCSIS. SIP is a signaling protocol used for setting up and tearing down real-time communications sessions (voice, instant messaging, etc.). PacketCable is a standards definition maintained by CableLabs, designed for the cable TV industry; it’s used for real-time multimedia services delivered using cable networks. DOCSIS, which stands for Data Over Cable Service Interface Specification is also developed by CableLabs, and defines both communications and operation support interface requirement for data over cable systems.

*Security:* Protecting user privacy and the security of applications and data from those looking for illicit profits or with malicious intent will be key to establishing and

maintaining consumer trust in the mobile platform for protection of privacy and data and even more so as a safe means for conducting commercial transactions.

*Mobile channel:* Mobile Channel Characteristics introduces the principal transmission phenomena of mobile and personal communication - the ones that affect design of modems, channel simulators, smart antennas, and other system components at the physical level.

*Mobile Services:* Mobile services are provided by different service providers like facebook developer, Amazon Web services, IBM etc.

## 4 Working of Mobile Cloud Computing

When a mobile subscriber starts using a mobile application the further process depends on whether the application needs a cloud service or not. If the application does not require cloud services then it interact with Mobile Switching Centre (MSC) through various uplink channels for common mobile application like registration, call setup, call termination and SMS etc.

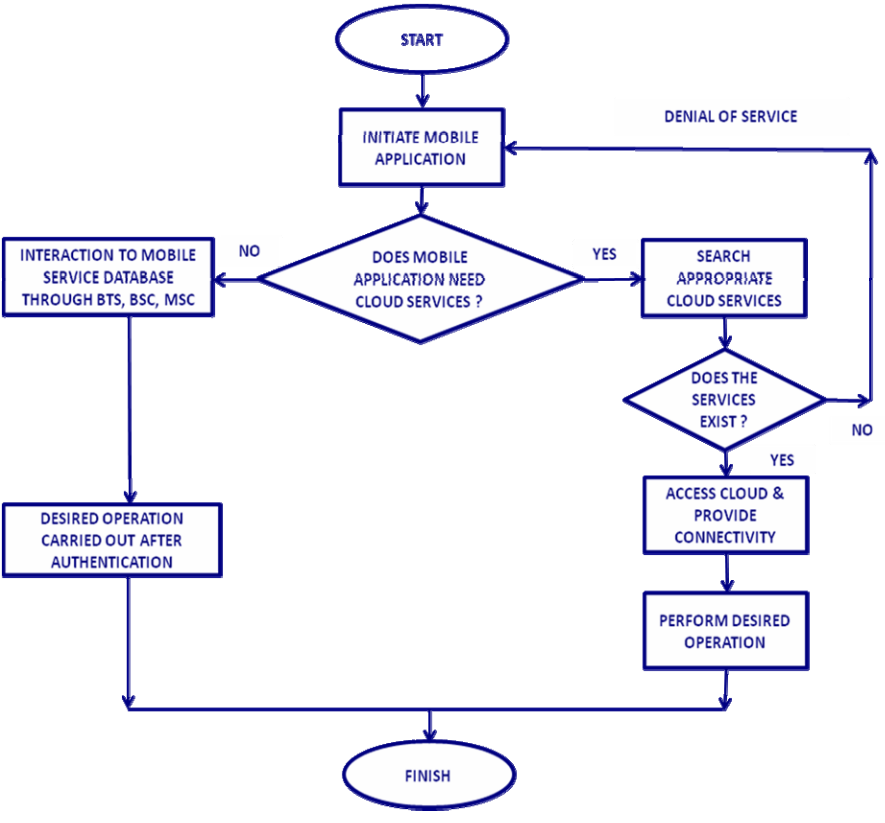


**Fig. 3.** Flow of Events in Mobile Cloud Computing

But if the application needs cloud services then appropriate cloud service provider is searched according to the mobile user's subscription. If the service requested by the subscriber is existing with the service provider then the connectivity is provided otherwise the service is denied. After the connection is established the cloud can be accessed. The connection can be established many number of times as needed by the subscriber. The payment is variable based on the actual consumption of the resources by the subscriber.

## 5 An Inspiring Example- Google Sync

One of the best examples of mobile cloud computing using Google is Google sync. Sync is a service provided by Google which allows synchronizing the built -in mobile applications, address book and calendar with users Google account. Once the user set up sync on his mobile it will automatically update phones contacts with contacts from his Gmail account. Sync will also download Google calendar to the user's mobile device. Using sync the mobile phone need not physically connect to laptop to transfer data.

Because sync works by backing up user's information from Google account the data is safe, even if phone is lost or damaged. Google Sync supports the iphone, Blackberry, Windows mobile, Android and Symbian Platform. On most devices, Google Sync uses the Microsoft Exchange ActiveSync Protocol. When setting up a new Exchange ActiveSync account on the mobile device, existing data may be removed from the phone. User should make sure to back up before setting up Google Sync.

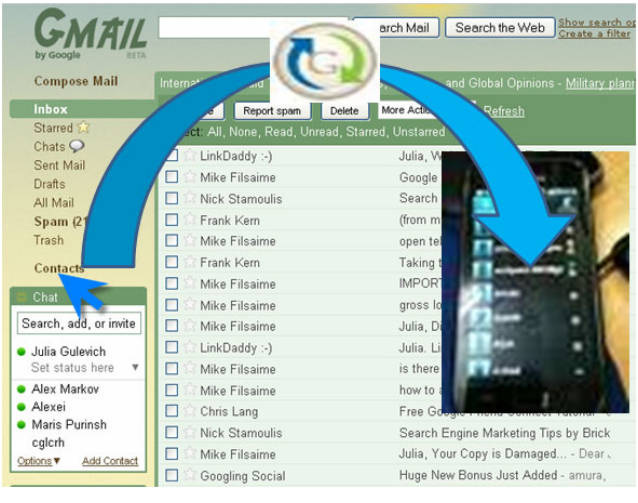


**Fig. 4.** Working of Google Sync

## 6 Services Needed by Mobile Cloud Client Server

The most essential services required by mobile client includes

1. *Sync:* This service synchronizes all state changes made to the mobile or its applications back with the Cloud Server.
2. *Push:* It manages any state updates being sent as a notifications from the cloud server.
3. *OfflineApp:* It is a service which carries the management capabilities to create smart coordination between low-level services like Sync and Push. It frees the programmer from the burden of writing code to actually perform synchronization as it is this service which decides synchronization management and mechanism which is best for the current state.
4. *Network:* It manages the communication channel needed to receive Push notifications from the server. It carries the ability to establish proper connections automatically.
5. *Database:* It manages the local data storage for the mobile applications. Depending on the platform it uses the corresponding storage facilities.
6. *InterApp Bus:* This service provides low-level coordination/ communication between the suite of applications installed on the device.

The most essential services required by mobile server includes

1. *Sync:* Server Sync service synchronizes device side App state changes with the backend services where the data actually originates. It also must provides a plug-in framework to mobilize the backend data.
2. *Push:* Server Push service monitors data channels for updates. The moment updates are detected, corresponding notifications are sent back to the device.
3. *Secure Socket-Based Data Service:* Depending on the security requirements of the Apps this server side service must provide plain socket server or a SSL-based socket server or both.
4. *Security:* Security component provides authentication and authorization services to make sure mobile devices connecting to the Cloud Server are in fact allowed to access the system.
5. *Management Console:* Every instance of a Cloud Server must have a Command Line application such as the Management Console as it provides user and device provisioning functionalities.

## 7 PROS and CONS of Using Mobile Cloud Computing Services

Cloud computing actually is not a new term as it has been used since few years ago in services like web-based emails, peer-to-peer networks and other web applications. But with the growth of mobile devices users and the rise of Social Networking sites, the demand of mobile cloud computing services will continue to grow. As an online service, mobile cloud computing also has pros and cons.

**Pros**

*Flexibility:* With mobile cloud computing, users can access the applications and data from anywhere and any devices as long as they have internet connections and web browsers.

*Availability:* Since most of mobile cloud computing services are provided by third party, they usually set a high standard quality of their applications and data availability. Besides, since all data are available on the cloud online, it can be updated in real time and at the same time other people also can access to the same data as well.

*Platform support:* Unlike native applications which are built specifically for single platform, cloud computing services usually built with broader support of platforms as long as they have compatible browsers.

**Cons**

*Connectivity:* Since all mobile cloud computing services are available online, the internet connectivity becomes critical. So when choosing apps or services for your personal or business use, make sure you pay attention on this aspect.

*Performance:* Like common online services, the performance of mobile cloud computing services is also sometimes questionable compared to native applications. So it becomes important to see the service provider's track record before you decide to use the service.

*Security:* Some applications which use cloud computing services often deal with sensitive personal information like credit cards, etc. So it could become a serious problem if the service providers can't provide a high level of security.

## 8 Conclusion

In this paper, we have proposed a three tier framework of Mobile based cloud computing. Here, we have put forward the different components of the framework along with their services. The concept of cloud computing provides a brand new opportunity for the development of mobile applications since it allows the mobile devices to maintain a very thin layer for user applications and shift the computation and processing overhead to the virtual environment. In this day to day changing technology environment, demands of the users also changes. Users demands quality service at anytime and anywhere with speed and accuracy. Hence Mobile Cloud Computing could be a possible solution up to some extent.

## References

1. Research Report by ABI Research, Mobile+ Cloud+ Computing (2009), http://www.abiresearch.Com/1003385
2. Mell, P., Grance, T.: Draft nist working definition of cloud computing, vol. 15 (August 21, 2005) (2009)

3. O'Gara, M.: Washington itching to take the lead on cloud computing. SOA Journal (July 31, 2009)
4. IDC, Press Release: IDC Finds Cloud Computing Entering Period of Accelerating Adoption and Poised to Capture IT Spending Growth Over the Next Five Years (October 20, 2008)
5. Hamm, S.: How cloud computing will change business. Business Week (June 4, 2009)
6. Velte, T., Velte, A., Elsenpeter, R.C.: Cloud Computing: A Practical Approach. Tata McGraw-Hill Professional (2009)