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Power Management in Mobile Cloud Computing

Nola T P[1], V R Nagarajan[2]

M Phil Student, Department of Computer Science, Sree Narayana Guru College, Coimbatore, India[1]

Assistant Professor, Department of Computer Science, Sree Narayana Guru College, Coimbatore, India[2]

Abstract: Cloud computing is an expression used to describe a variety of computing concepts that involves a large number of computers connected through a real-time communication network known as internet. It enables a program or an application to run on many connected computers at same time. Mobile Cloud Computing is an emerging technology where both data storage and data processing happens outside the mobile device. Mobile devices are increasingly becoming an essential part of human life and a powerful trend in the development of Information Technology. However, the mobile devices are facing many challenges with respect to their resources such as battery life, bandwidth and storage. This project deals with a study of Mobile Cloud Computing based on the issues relate to the battery life of mobile phone. The Objective is to show how battery life of the phone can be saved by using Mobile Cloud Computing Technology.

Keywords: Mobile Cloud Computing, Battery power, Power Tutor, Mobile Devices, Android Applications

I. INTRODUCTION

Together with an explosive growth of the mobile applications and emerging of Cloud Computing concepts, Mobile Cloud Computing has been introduced to be a potential technology for mobile services. Mobile Cloud Computing integrates cloud computing into the mobile environment and overcome obstacles related to performance in the battery life and storage. This is a new paradigm for mobile applications whereby data processing and storage are moved from the mobile device to powerful centralized computing platforms located in clouds. These centralized applications are then accessed over the wireless connection based on the native clients or web browser on the mobile devices.

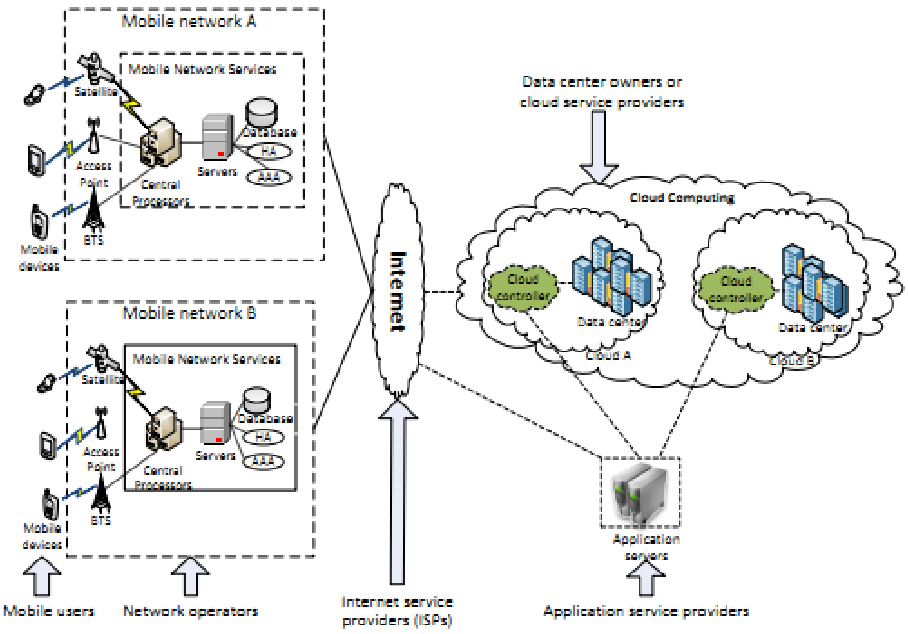

Fig 1. Architecture of Mobile Cloud Computing

Fig. 1 demonstrates the architecture of mobile cloud computing, in this the mobile devices are connected to the mobile networks via a base stations (e.g., base transceiver station, access point and satellite) that establish and control the connections and functional interfaces between the networks and mobile devices. Here mobile network operators can provide services to mobile users as authorization, authentication and accounting based on the home agent and subscribers data stored in databases. After that the subscribers request are delivered to the cloud through the internet. In the cloud, the cloud controllers process request to provide users with the corresponding cloud services.

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II. System Architecture

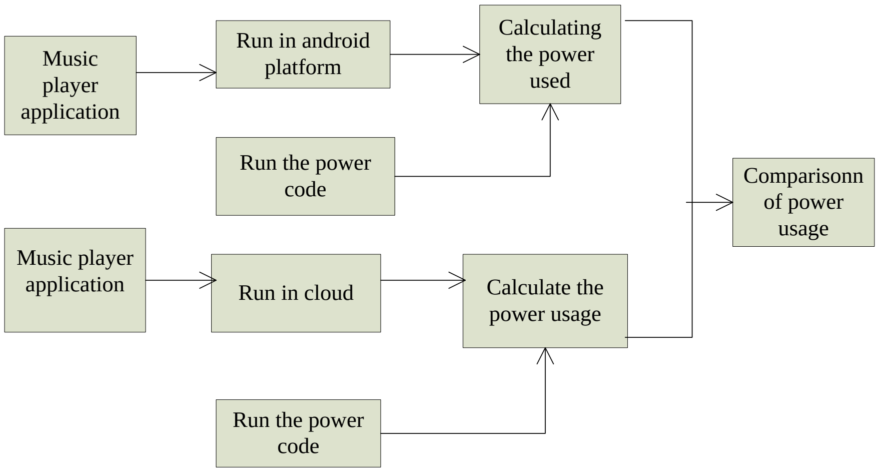

Fig 2. System Architecture

The system architecture in Fig. 2 defines the whole process of the system. The music player application is deployed and it is run on the android platform as well as on the cloud platform. The power code is run on both the platforms to estimate the battery power consumed by the applications. The result is formed with the comparative study of the battery usage.

III. PROPOSED SYSTEM

Mobile devices obtain the energy required for their operation from batteries. In the case of many consumer electronics devices, especially mobile phones, battery capacity is severely restricted due to constraints on weight and size of the device this implies that energy efficiency of these devices is very important to their usability. Hence, the optimal management of power consumption of these devices is critical. Mobile Cloud Computing is developed to enable mobile users to store and access the large amount of data on the cloud through wireless networks. First example is the Amazon Simple Storage Service (Amazon S3) which supports file storage service. Development of battery technology has not been able to match the power requirements of the increasing resource demand. The amount of energy that can be stored in a battery is limited and is growing 5% annually which is negotiable. Therefore, bigger batteries resulting into larger devices are not an attractive option. Through this research a detailed study of the power consumed by mobile devices while running mobile applications is performed.

A. Creating Mobile Application

There are various platforms available in the market to develop an android mobile application. App Builder Appy Pie is a no-code mobile application builder tool. It is the fastest growing cloud based Mobile Apps Builder Software (App Maker) that allows users with no programming skills, to create Android & iPhone applications for mobiles and smart phones; and publish to Google Play & iTunes. With App Builder Appy Pie, there is no need to install and download outside components, applications can be created online with drag and drop app pages. A simple application (Music Player) is developed using App Builder. The application is installed on the phone environment and it can be run in both phone and cloud(using browser) via phone. The Fig. 3 is the application created using Appy Pie.

Fig 3. Mobile Application

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B. Using Power Tutor

Power Tutor is an application for mobile phones that displays the power consumed by major system components such as CPU, network interface, display, and GPS receiver and different applications. This application allows software developers to see the impact of design changes on power efficiency. Application users can also use it to determine how their actions are impacting the battery life. Power Tutor uses a power consumption model built by direct measurements during careful control of device power management state.

This device model generally provides power consumption estimates within 5% of actual values. And a configurable display for power consumption history is provided. It also provides users with a text-file based output containing detailed result. Each hardware component in an android phone has a couple of power states that influence the phone's power consumption. For example, CPU has frequency level and CPU utilization, OLED/LCD has brightness level. In Power Tutor the power model is constructed by correlating the measured power consumption with these hardware power states. The power states considered in the power model includes:

- CPU: Frequency level and CPU utilization.
- OLED/LCD: For hardware with LCD screen and OLED screen without root, brightness level is considered; for hardware with OLED screen with root access, brightness together with pixel information displayed on the screen is considered.
- Wi-Fi: Uplink data rate, Uplink channel rate, and packets transmitted per second.
- 3G: Power states and Packets transmitted per second.
- GPS: Power states of the GPS device (active, sleep, off) and Number of satellites detected.
- Audio: Power states of Audio device (on, off).

Fig. 4 shows the Power Tutor Application on the mobile environment for calculating the power consumed by the application on the phone and the cloud.

Fig 4. Power Tutor

C. Power optimization Evaluation

The developed android mobile application is made to run in the phone with manually calculated time, the power tutor is made on with start profile. In Fig. 5 the Application viewer profile showed 6.5J in Media Server while the application is being played in the cloud environment, whereas the Application viewer showed 9.9J when the application is run on mobile device. This shows how effectively we can save battery power by using Cloud for running Mobile applications.

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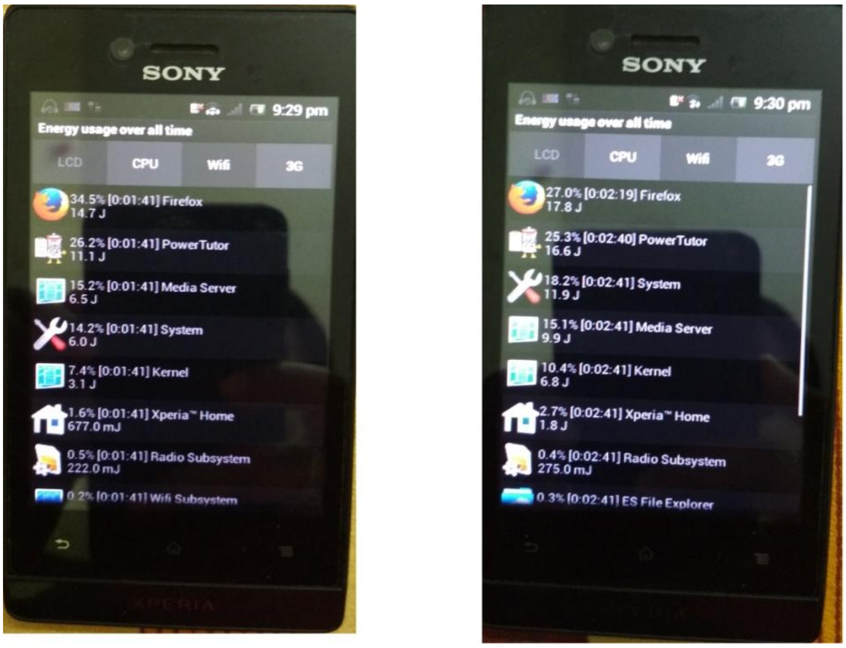

Fig 5. Power Optimized Result

IV. CONCLUSION

The Battery power consumed by the music player in the android device is measured correctly by the Power tutor application. Our analysis suggests that cloud computing can potentially save energy for mobile users. However, not all applications are energy efficient when migrated to the cloud. Mobile cloud computing services would be significantly different from cloud services for desktops because they must offer energy savings. The services should consider the energy overhead for security, privacy, reliability and data communication before offloading.

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