Battery Efficiency of Mobile Devices through Computational Offloading: A Review

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***Abstract*—Smart Internet Devices (SIDs) particularly Smartphones are soon turned to be super computers, while the restricted battery timing is a focused issue which hinders the steady meeting expectations yield of these devices. In addition, various sensors, high resolution LCDs, wireless interfaces, GPS and other advanced features drain battery quickly, thus, shrinking the operational time. Subsequently, increasing battery life of SIDs has happened to dire investigation significance at hardware and programming levels, both alike. The intention of our work is to evaluate computational offloading; sending power-intensive processing to remote servers in cloud and accepting the outcome back on device's screen. Furthermore, this paper gives a review of previous research work on computational offloading. We then summarize distinct research work with their respective findings and limitations. In addition, a short critical analysis of the review works following the summarized data**.

Keywords: Mobile Cloud Computing; Mobile Computing; Cloud Computing; Computational Offloading, Surrogates;

I. INTRODUCTION

The incredible progression in technology evolved the way of today's communication and computation. Starting from abacus and mainframe till the modern Smartphone, a dominant development can be seen which was seemed impossible few decades back. On the other hand, emerging of high computational intensive applications in mobile computing environment such as, online video games, natural language translators, speech recognizers, and wearable sensors increased user's expectations, while they need high computing power, battery life and storage memory in the resource constrained devices (SIDs) [1].

The restricted battery timing of these devices is a focused issue; hindering the total operational time. In 2005, a survey conducted in 15 countries found that augmented battery time is the most significant feature compare to the rest of Smartphone's features, including; storage and cameras [2]. A comparative review directed in 2009, by Change Wave Research, established that short battery life is the most aversion feature of mobile device, including iPhone 3GS(RFF). Similarly, in 2009 Nokia survey found that battery life is one of the main issues toward clients. Conversely , the vast majority of the software developers are concerned with the physical up-gradation and of advance applications, for example, processing speed, memory capacity, Sensors [3], while battery conservation is largely ignored. As a result, Smartphone/SIDs sometime fails to provide the reliable functionalities.

The extreme infiltration of mobile devices in the market drives a strong demand of new services that may possibly minimize the uncertainty in reliable communication and services availability. It is crucial for the present cloud providers and infrastructure developer to focus on energy concerns and challenges. Therefore, it is essential to think about and analyze the ongoing research on energy saving of mobile devices. The goal of this paper is to portrait the past and on-going research on augmentation of mobile batteries by using the computation offloading. Likewise the paper investigates the impediments, future needs and issues of the current research.

The paper structured as; Section II refers to a short background of Mobile Cloud Computing (MCC) and Cloud Services utilization. Section III consists of the mathematical evaluation of Computation Offloading. Section IV consists of offloading steps. Section V provides a summary and critical analysis with limitations and future work of previous research. Section VI concludes the paper. Section VII entails of acknowledgment.

II. BACKGROUND

A. Mobile Cloud Computing

Due to varied interpretations of researchers' Mobile Cloud Computing defined at many ways. Eric Schmidt (CEO Google) in 2010 defined as "based on Cloud Computing services development, mobile phones will become increasingly complicated and evolve to a portable super computer [4]". Aepona defined MCC as [5]" a new distributed computing paradigm for mobile applications whereby the storage and the data processing are migrated from the SID,s to resources rich and powerful centralized computing data centers in computational clouds.

By Satyanarayanan [6], the pervasive nature of devices intrinsic problems such as, finite battery timing, low connectivity, limited processing speed and memory. To combat with the insufficient capabilities of mobile devices, cloud computing turned to a ruling model provide an infinite pool of resources to efficiently accomplish the resource scarcity problems by remote computation and utility services. Cloud services are provided by the service providers. Google, Amazon, Facebook, Apple, Yahoo, are considered the big players in the list of service providers. The Cloud Providers provides such an infrastructure where both, the processing and data storage happens outside of the mobile device and it termed as "Mobile Cloud". Thus, Cloud Computing is a novel model, encompasses Cloud Computing, Mobile Computing and Networking.

The model composed of mobile computing and Cloud computing bridged by Internet as shown in Fig.1.The mobile device connects to a network through base stations [7] (i.e. Satellite, Access Points, BTS) that build up and control associations between the systems and mobile devices. The