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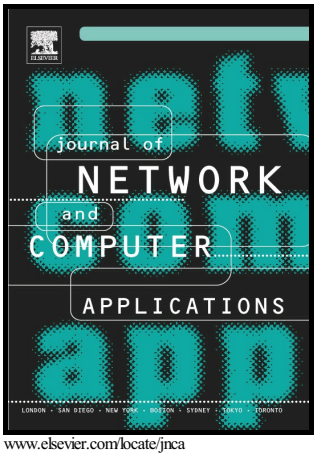

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Towards native code offloading based MCC frameworks for multimedia applications: A survey

Junaid Shuja[a], Abdullah Gani[a], Muhammad Habib ur Rehman[b], Raja Wasim Ahmad[a], Ejaz Ahmed[a], Sajjad A. Madani[c], Muhammad Khurram Khan[d], Kwangman Ko[e]

[a]Centre for Mobile Cloud Computing Research (C4MCCR), FSKTM, University of Malaya, Malaysia
[b]Faculty of Computer Science and Information Technology, University of Malaya, Malaysia
[c]COMSATS Institute of Information Technology, Islamabad
[d]Center of Excellence in Information Assurance (CoEIA), King Saud University, Riyadh, Saudi Arabia
[e]School of Computer and Information Engineering, Sangji University

junaidshuja@siswa.um.edu.my
abdullah@um.edu.my
mhrehman@siswa.um.edu.my
wasimraja@siswa.um.edu.my
imejaz@siswa.um.edu.my
madani@comsats.edu.pk
mkhurram@ksu.edu.sa
kkman@sangji.ac.kr

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Abstract

A number of resource-intensive applications, such as augmented reality, natural language processing, object recognition, and multimedia-based software are pushing the computational and energy boundaries of smartphones. Cloud-based services augment the resource-scare capabilities of smartphones while offloading compute-intensive methods to resource-rich cloud servers. The amalgam of cloud and mobile computing technologies has ushered the rise of Mobile Cloud Computing (MCC) paradigm which envisions operating smartphones and modern mobile devices beyond their intrinsic capabilities. System virtualization, application virtualization, and dynamic binary translation (DBT) techniques are required to address the heterogeneity of smartphone and cloud architectures. However, most of the current research work has only focused on the offloading of virtualized applications while giving limited consideration to native code offloading. Moreover, researchers have not attended to the requirements of multimedia based applications in MCC offloading frameworks. In this study, we present a survey and taxonomy of state-of-the-art MCC frameworks, DBT techniques for native offloading, and cross-platform execution techniques for multimedia based applications. We survey the MCC frameworks from the perspective of offload enabling techniques. We focus on native code offloading frameworks and analyze the DBT and emulation techniques of smartphones (ARM) on a cloud server (x86) architectures. Furthermore, we debate the open research issues and challenges to native offloading of multimedia based smartphone applications.

Keywords: **virtualization, emulation, Mobile Cloud Computing, Dynamic Binary Translation, SIMD.**

I. INTRODUCTION

Smartphones have become a vital part of daily human life while providing applications like health monitoring, e-gaming, and social networking. The foremost goal of smartphones and modern mobile devices is to provide end-users with interactive features within the limited resources of battery, computation power, and network accessibility. However, smartphone applications, such as voice and image recognition, augmented reality, and health monitoring are pushing the limits of computational power and testing the long-term battery operations [1]. Modern mobile devices are multi-core, with high computational power and storage capacity. Still, smartphones remain resource-scarce as compared to desktop systems and cloud servers. While the absolute ability of mobile devices will increase over the years, their relative ability will remain low as compared to server devices [2], [3].

Cloud Data Centers (CDC) are an ideal candidate for augmentation with resource-scarce mobile and smartphone devices. CDCs comprise of thousands of server, storage, and network devices interconnected with each other to provide flexible pay-as-you-go business model to end users [4], [5]. The paradigm of Mobile Cloud Computing (MCC) was established with the amalgam of Mobile Computing (MC) and Cloud Computing (CC) [6]. Precisely MCC can be defined as an alliance of cloud computing technologies with modern smartphone and mobile devices to make them resource-full in terms of computational power, storage, and energy [7], [1].

The MCC paradigms functions in two major directions. Firstly, cloud computing technologies can enhance mobile features with cloud augmented applications. The major examples of such applications are cloud enabled email services (Gmail), social media applications (Facebook), and messaging applications (WhatsApp). The second dimension of MCC is the utilization of code offloading techniques to offload compute-intensive application instances or methods to a cloud server. The computational offloading is also termed as cyber- foraging [8], [9]. The major focus of this study is the computational offloading based MCC techniques that offload multimedia applications from resource-scarce smartphones to resource-rich cloud servers. The computational offload can be in the form of process state, compiled or pre-compiled code, intermediate byte-coded application,

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