How virtualisation helps smart phones in cloud computing: A survey

*Joshi Rakhi[#1], Prof. V.B. Maral[*2]*

[#1] *Department of Computer Engineering, KJ College of Engineering and Management Research, Pune, India*

[1]bhardwaj.rakhi@gmail.com

[2]vikasmaral@gmail.com

Abstract -The limited capability and energy constraint of smart phones leads to the usage of cloud computing. Features provided by the cloud aims to augment Smartphone capabilities by providing vast pool of computation power and unlimited storage space. However they are still constrained by limited computing, memory utilization and battery capacity. These limitations can be minimized in smart phones with the help of computation of f loading: sending heavy computation to resourceful servers and receiving the outcome from these servers. Offloading is the latest trend in mobile computing. In this survey paper we present how offloading can helps to increase the performance of smart phones by providing an overview of techniques, systems, and research areas for offloading computation. We will also describe scope for future research.

Keywords: Android, Cloud Computing and Client Server Model, Smart phones, Thin clients, computation offloading, Virtual Machine.

I. INTRODUCTION

Cloud provides great services which host everything; it may be data, applications or any other running programs. Cloud computing has emerged as a great technology in terms of scalability and portability. [1]

Though, we saw a significant development in processing capacity and memory in a cloud for Smartphone, it is still limited by its battery life. There is always a trade-off between the computation capacity and battery life. Portability, storage space and battery life are the main characteristics of a Smartphone.

Thousands of new applications are being developed every day which are one of the main energy consuming components in smart phones [2]. These applications not only maximized the software capability but also minimized the hardware limitation in a Smartphone. The cloud computing minimizes the energy needed for running computation vigorous applications in smart phones via offloading. [3][4]

Hardware independent computation is another important feature or which makes cloud computing unique. This reduces frequent hardware updates and enhances the scalability of the smart phones.

Although cloud computing can reduce the energy consumption in Smartphone for some cases, it is necessary to have analysis of end to end computing processing from smart phones to the servers. This is what we try to do in this paper. This paper presents analysis of offloading scenarios to arrive a conclusion whether offloading is a better option or not. Offloading web request can either be done via Wi-Fi or cellular data (3G/4G in our case). We will measure the performance of smart phones with respect to both the cases.

Figure 1: Overview of 3G communication [1]

Figure 2: Overview of Wi-Fi communication [1]
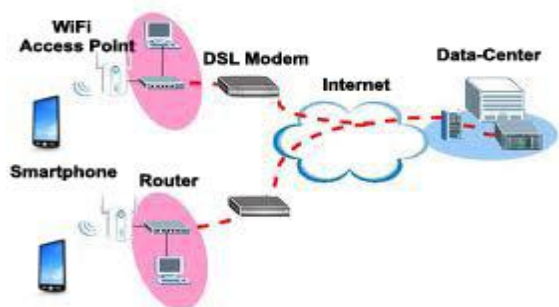
"Cloud computing is possible on smart phones either via Wi-Fi or cellular data. No research has been done on cloud computing involving cellular data even though it is the most widely popular medium of communication as it is widely available compare to Wi-Fi."[1]

II. RELATED WORK

Many researchers believe that cloud computing is an excellent media to help reduce battery consumption of smart phones, as well as to enhance the computation and storage performance with the help of offloading.[5] The two main components of an offloading system are:

1. Components on the client – the mobile device
2. components in the environment – either a cloud, a cloudlet, a peer device, or a hybrid environment

In past decade few approaches have been proposed for offloading applications from a Smartphone to the cloud, which includes offloading the complete application, offloading partially. Related work in the field of offloading applications from android phones to the cloud has been discussed below.

In 1998, Alexey Rudenko proposed a scheme to enhance the battery life of a laptop through wireless remote processing of power costly tasks. They proposed that the battery life of a laptop could be increased by shifting the power costly tasks onto a server through wireless connectivity or the internet. Computation and processing has been taken off from laptop to server with less battery power than previous.

Year 2009 launches the idea of augmented Smartphone applications through clone cloud execution by Byung Gon Chun and Petros Maniatis. This research proposed to augment the Smartphone's capabilities by offloading an application partially or completely to a clone Smartphone. A clone is a virtual system on the cloud running the same operating system as that of the phone using hardware from the cloud's pool of hardware. [7][8]The application is offloaded partially to reduce the load on the Smartphone. While the intensive part of computing is being executed by the clone and the actual mobile device executes the remaining application. After the execution of the clone results arrived to the actual phone. The phone processes the results to the user.

Byung Gon Chun et al. in the year 2011 implemented an architecture named clone cloud for offloading an application partially to its clone in cloud. This scheme Usually uses a partitioning analyzer which partitions the application to be offloaded for remote execution.[8][9] The partition analyzer has a static analyzer which discovers the possible migration points and the constraints for migration and a dynamic profiler to build a cost model for execution and migration. In the year 2011, a new approach of the applications from android Smartphone to the cloud was introduced by Eric Y. Chen and Mistutaka Itoh named virtual Smartphone over IP. In this approach the complete application was offloaded from the android Smartphone to the cloud. In this approach it was proposed to provide cloud computing environment specifically tailored for Smartphone users.[10][11] This architecture allows users of smart phones to create virtual Smartphone images in the cloud and install and run their applications in these images remotely. The user can create a number of smart phone images using a dedicated server for each user.

In 2010, Georgios Portokalidis et al. proposed a new scheme named paranoid android to provide security to android phones by applying security checks on remote security servers that host exact replicas of the smart phones in virtual environments. [13][15]

Another system named MAUI was introduced in 2010 by Eduardo Cuervo et al. MAUI enable fine-grained energy aware offload of mobile's code to a cloud based infrastructure. MAUI approach uses code portability to create two versions of a mobile application, one runs locally on the Smartphone and the other runs remotely in the infrastructure. While managed code enables MAUI to ignore the differences in the instruction set architecture between today's mobile devices (which typically have ARM-based CPUs) and servers (which typically have x86 CPUs). MAUI combines the network and CPU costs with measurements of the wireless connectivity, bandwidth and latency to solve the problem of code offload. [7]

III. PERFORMANCE ANALYSIS

In this section we will represent the survey that will present the graphical presentation for how the offloading boosts the computation and storage performance of mobile device using virtualization. The performance here we will concern two factors:

- Energy performance for computation with and without offloading

- Network utilization

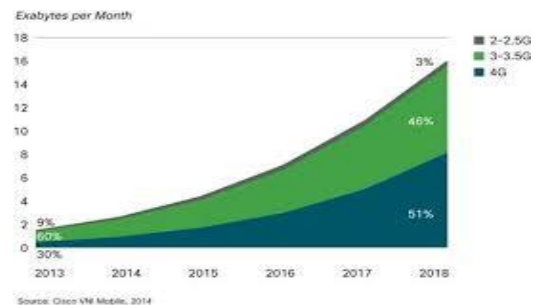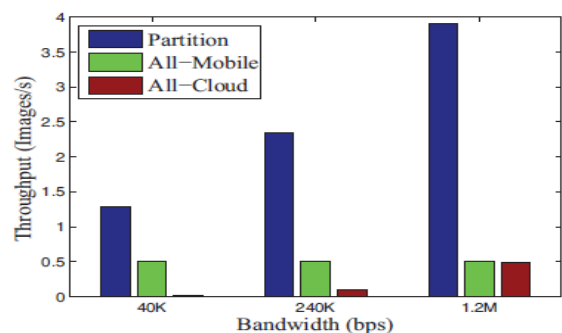FIGURE 4 (A): Network utilization using offloading [16]

FIGURE 4 (B): Data transfer using offloading [16]

FIGURE 4 (C): Energy efficiency for storage using offloading [16]

In terms of performance, from the figure 4(b), we can say that offloading scenarios take much less time compared to no-offloading scenarios. We can also summarize that the time taken when offloading using Wi-Fi is low compared to

that of 3G. This increase in time is because of higher communication time which is directly proportional to data rates. Typical data rates for 3G interface is 42 Mbps whereas that for Wi-Fi is 54 Mbps. [16]

IV. CONCLUSION AND FUTURE WORK

This paper surveys research associated with computation offloading for mobile systems. We examine how enablers like mobile agents and virtualization make offloading feasible. We survey different factors to improve performance or save energy. Finally we describe why Computation offloading plays lead role to increase the energy performance of mobile phones.

REFERENCES

[1] "Cloud Computing in Smart phone: Is offloading a better-bet?",Milindkumar H. Tandel, Vijay S. Venkitachalam,CS837-F12-MW-04A

[2] M. V. Barbera, S. Kosta, A. Mei, and J. Stefa, "To offload or not to offload? the bandwidth and energy costs of mobile cloud computing," in Proc. of IEEE INFOCOM, 2013.

[3] Karthik Kumar · Jibang Liu · Yung-Hsiang Lu ·,"A Survey of Computation Offloading for Mobile Systems",Mobile Netw Appl DOI 10.1007/s11036-012-0368-0,© Springer Science+Business Media, LLC 2012

[4] Karthik kumar and yung-hsiang lu,"cloud computing For mobile users: can offloading computation save energy?",0018-9162/10/$26.00 © 2010 IEEE

[5] Abhinav Pathak,, Charlie Hu,Paramvir Bahl,Yi-Min Wang 'Enabling Automatic Offloading of Resource-Intensive Smartphone Applications", http://docs.lib.purdue.edu/ecetr

[6] Alexandru-Corneliu, OLTEANU1, Nicolae, 'OFFLOADING FOR MOBILE DEVICES: A SURVEY', U.P.B. Sci. Bull., Series C, Vol. 76, Iss. 1, 2014 ISSN 2286 – 3540

[7] E. Cuervo, A. Balasubramanian, D.-k. Cho, A. Wolman, S. Saroiu, R. Chandra, and P. Bahl, "MAUI: Making Smart phones Last Longer with Code Offload," in Proceedings of the 8th international conference on Mobile systems, applications, and services (ACM MobiSys '10). San Francisco, CA, USA: ACM, 2010, pp. 49–62.

[8] B.-G. Chun and P. Maniatis, "Augmented Smart phone Applications Through Clone Cloud Execution," in Proceedings of the 12th Workshop on Hot Topics in Operating Systems (HotOS XII). Monte Verita, Switzerland: USENIX, 2009.

[9] Paramvir Bahl,Richard Y. Han,Li Erran Li,Mahadev Satyanarayanan,"The Case for VM-based Cloudlets in Mobile Computing",Microsoft Research,University of Colorado,Bell Labs. Lien Deboosere,Bert Vankeirsbilck,Pieter Simoens,Filip De Turck,

[10] Niroshinie Fernando ∗ , Seng W. Loke ∗ , Wenny Rahayu" Mobile cloud computing: A survey", 0167-739X/$ – see front matter © 2012 Elsevier B.V. All rights reserved. doi:10.1016/j.future.2012.05.023

[11] M. Satyanarayanan, P. Bahl, R. C´aceres, and N. Davies, "The Case for VM-Based Cloudlets in Mobile Computing," IEEE Pervasive Computing, vol. 8, no. 4, pp. 14–23, Oct. 2009.

[12] "Toward a Unified Elastic Computing Platform for Smart phones with Cloud Support",Weiwen Zhang and Yonggang Wen,Jun Wu,Hui Li,0890-8044/13/$25.00 © 2013 IEEE.

[13] Antti P. Miettinen,Jukka K. Nurminen , Nokia Research Center "Energy efficiency of mobile clients in cloud computing".

[14] Dong huang, ping wang,dusit niyato,"a dynamic offloading algorithm for mobile computing",ieee transactions on wireless communications, vol. 11, NO. 6, JUNE 2012

[15] Muhammad Shiraz1, Abdullah Gani2."Mobile Cloud Computing: Critical Analysis of Application Deployment in Virtual Machines",2012 International Conference on Information and Computer Networks (ICICN 2012)IPCSIT vol. 27 (2012) © (2012) IACSIT Press, Singapore.

[16] https://www.google.co.in

[17]