AUGMENTATION OF PERFORMANCE AND ENERGY-EFFICIENCY OF SMART PHONES IN CLOUD-ASSISTED ENVIRONMENT

NANCY ARYA, DR. SUNITA CHAUDHARY, DR. S.TARUNA

Abstract: The vogue of smart phones creates an affluent user experience, but the hardware limitations of smart phones for instance storage, computation, and power capacity are still a major issue. Though smart phones of current generation have powerful resources, but battery backup and performance of smart phones is still a bottleneck. Battery is one of the main constraint for smart phones because it depends on a fixed supply of energy that is contained in its battery. Power capacity of mobile devices can enhance by only 5% per annum by using the avant-garde technologies. Thus, it is a major challenge to enhance energy efficiency and performance of resource constrained device. Mobile Cloud Computing (MCC) employs augmented execution for enabling highly computational intensive applications on smart phones. This paper provides the solution to augment the performance and energy efficiency of resource intensive and energy consuming mobile applications in cloud based environment.

Keywords: Cloud Assisted Mobile Computing; Power capacity; Augmented Execution; Offloading.

Introduction: The combination of a ubiquities mobile network and cloud computing engender a new computing paradigm known as mobile cloud computing. It is a new model for mobile applications where data processing and storage are moved from mobile device to powerful and centralized computing platforms located in clouds over the internet [12]. The technology of mobile cloud computing integrates the cloud computing with mobile environment to overcome the obstacles of performance, security and environment [6]. According to the study of juniper research [2], the cloud computing based mobile software and applications are expected to rise 88% annually from 2009 to 2014. By Allied Business Intelligence (ABI) research, more than 240 million businesses are using cloud services through mobile devices by 2015. It will push the profit of mobile cloud computing to $5.2 billion. Smart phones are now capable of supporting a large number of applications which demands high computational power. The mobile devices are facing so many challenges such as limited battery life, low bandwidth, less storage, security and processor performance etc. as these are low potential computing devices. Smart phones such as iPhones, android mobile serials, and windows serials decrease 3 times in processing capacity, 8 times in memory, 5 to 10 times in storage capacity and 10 times in network bandwidth [12, 13]. Smart phones are now capable to run various resource hungry multimedia applications which drain the battery swiftly. Energy is the unreplenishable resource in mobile devices that cannot be restored spontaneously and needs external resources to be renewed [9]. According to nokia poll (2009), battery life is one of the greatest concerns for users. Battery life of mobile devices is a key limiting factor in the design of mobile applications. These restrictions may be alleviated by offloading which send heavy computational data to resourceful servers and then receive the results back from these servers. It is a technique to overcome the limitations of mobile devices related to computation, storage, and battery [5,8, 11]. Offloading is different from client server architecture [14]. The offloading depends on number of parameters such as the network bandwidth, type of applications and the amount of data exchanged etc. [14]. Several state-of-the-art technologies and frameworks exists to focus on the saving energy and enhancing the performance using the technique of computation offloading [1,3, 4, 7, 10, 15, 16, 17, 18]. Thus, it is essential to focus on energy and performance issues of mobile devices.

Related work: Several computational offloading frameworks and techniques has been developed in the recent years, some of them emphasizes on energy efficiency others focus on the performance augmentation and very few emphasizes on enhancement of energy and performance both.

Proposed work: Mobile applications contains small intensive and tightly coupled components. The solution emphasizes to augment the energy efficiency and performance by migrating minimal instances of intensive applications on cloud datacenters. The instances of computational intensive application can be minimized at runtime by employing computational task offloading as the primary offloading rather than migration of intensive component. As an outcome, the cost of energy consumption will reduce in remote processing of intensive components of the mobile application. The proposed solution decides what instances of intensive components of the mobile application will offload, how to offload the components of application and where to offload the intensive components. To achieve the goal, solution divide the components of mobile application into two parts to migrate the most intensive part of the application for remote processing. The partitioning depends on various input conditions of cloud node and mobile device such as type of application (multimedia, text editors, gaming, and calculators etc.), execution time on local device, resource utilization, CPU load, bandwidth between the devices and storage, available battery on devices etc. On the basis of results, least intensive part of the application executes on local mobile device and most intensive instances of the application will migrate to the cloud node for execution.

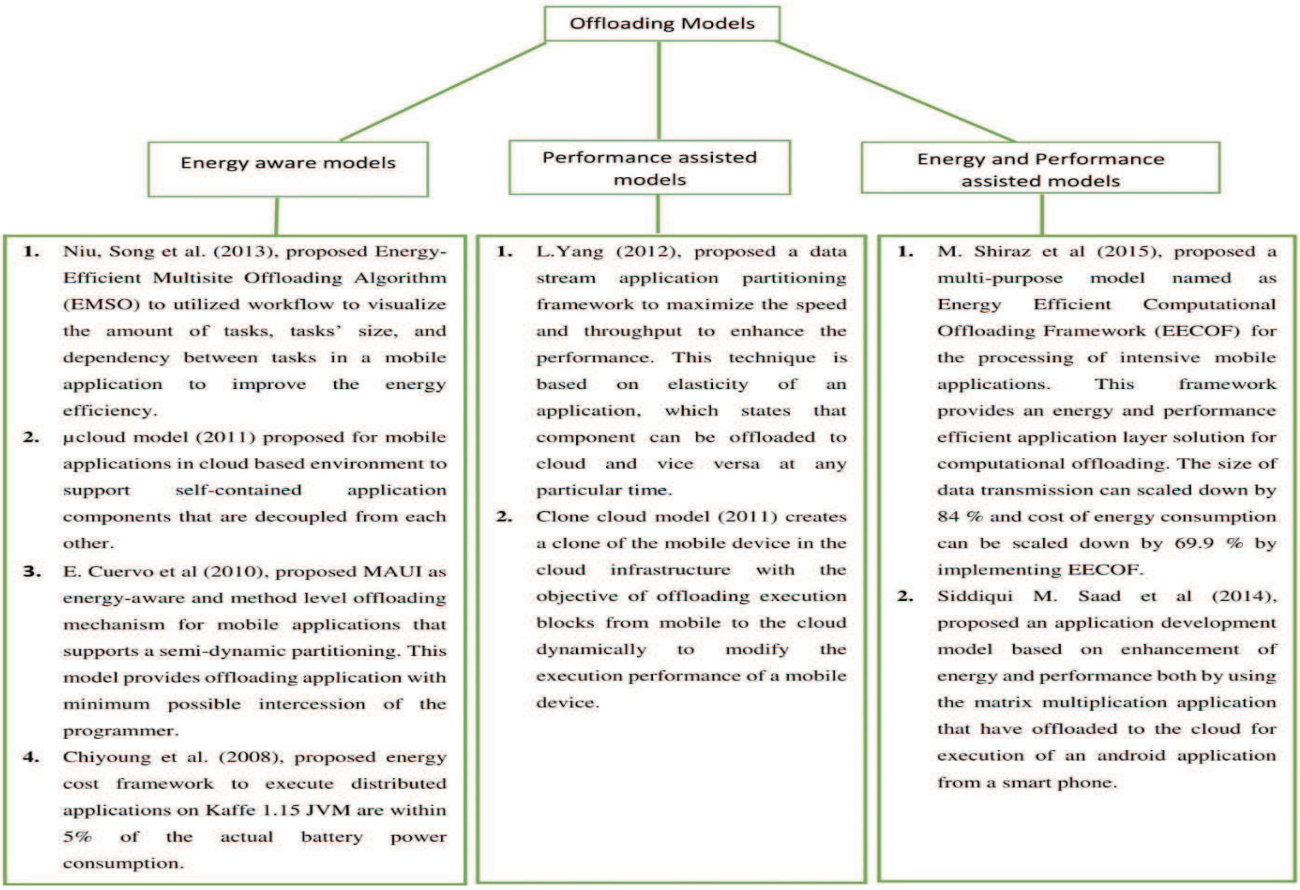

Fig. 1. Related work of different offloading model

Execution time and resources utilization for the mobile device and turnaround time of the application on the cloud (remote server) are analyzed. By sending the most intensive instances of the application for remote processing at runtime will reduce the increased overhead that results augmented energy efficiency and performance. Time required is indirectly proportional to the performance as well as energy efficiency. Thus, total time (T_t) taken by data to migrate from mobile to cloud (remote server) can be calculated by including the time spent on memory to fetch data and to writing back (T_m), network transmission time (T_n), total time spent on the cloud (T_c), and time taken by third party interface (T_i). Third party interface is any third party vendor that provides the communication between mobile and cloud. **Total Time (T_t) = time spent on memory to fetch data and to writing back (T_m) + network transmission time (T_n) + total time spent on the cloud (T_c) + time taken by third party interface (T_i).** Time of interface should not be greater than total transmission time ($T_i < T_t$). By using this above formula, total amount of time of offloading from mobile to cloud can be calculated. By reducing this total amount of transmission time, performance and energy efficiency may be increased gradually.

Conclusion: The proposed solution addresses the issue of additional energy consumption in computational offloading for mobile cloud computing due to the lack of distributed architecture. The paper also concludes that energy efficiency and performance can be augment by reducing an increased overhead. Total time is required is indirectly proportional to the performance as well as energy efficiency. This solution provides a better approach to augment the energy efficiency and performance of resource demanding and energy consuming cloud-assisted mobile applications by reducing the total amount of time to offload from local node to remote server.

References:

1 Abdullah Gani, Azra Shamim, Muhammad Shiraz, Raja Wasim Ahmad, Suleman Khan, "Energy Efficient Computational Offloading Framework for Mobile Cloud Computing", Article In Journal of Grid Computing, Impact Factor: 1.51, 2015.
2 S. Perez, Mobile cloud computing: $9.5 billion by (2014), http://exoplanet.eu/catalog.php
3 Gran Badshah, Jasni Mohamed Zain, Mohammad Fadli Zolkipli, Mushtaq Ali, "Mobile Cloud Computing & Mobile Battery Augmentation Techniques: A Survey", IEEE, (2014).
4 S.C.Nandedkar, Siddiqui Mohammad Saad, "Energy Efficient Mobile Cloud Computing", IJCSIT, Vol. 5 (6), 7837-7840, ISSN: 0975-9646, (2014).
5 Dhammapal Tayade, "Mobile Cloud Computing: Issues, Security, Advantages, Trends", IJCSIT, Vol. 5 (5), 6635-6639, ISSN: 0975-9646, (2014).
6 Gaurav, Jitender Kumar, Nitesh Kaushik, "A Literature Survey on Mobile Cloud Computing: Open Issues and Future Directions", IJECS, Vol 3, Issue 5, ISSN: 2319-7242, (2014).
7 Rifang Niu, Wenfang Song, Yong Liu, "An energy efficient multisite offloading algorithm for mobile devices". International journal of distributed sensor networks ,(2013) .
8 Abdullah Gani, Ejaz Ahmed, Rajkumar Buyya, Saeid Abolfazli, Zohreh Sanaei, "Cloud-Based Augmentation for Mobile Devices: Motivation, Taxonomies, and Open Challenges", IEEE, (2013).
9 Schneider, "Essential characteristics of Mobile Cloud Computing", (2012).
10 Alvin T. S. Chan, Jiannong Cao, Lei Yang, Shaojie Tang, Tao Li, "A framework for Partitioning and Execution of Data Stream Application in Mobile Cloud Computing.", IEEE Fifth International Conference on Cloud Computing, (2012).
11 Dejan kovachev, Ralf Klamma, "Framework for Computation Offloading in Mobile Cloud Computing", International Journal of Interactive Multimedia and Artificial Intelligence, (2012).
12 Abdullah Gani, Han Qi, "Research on Mobile Cloud Computing : Review , Trend and Perspectives", Digital Information and Communication Technology and it's Applications (DICTAP), Second International Conference, Pages 195-202, (2012).
13 Deepak G, Pradeep B S, "Challenging Issues and Limitations of Mobile Computing", International Journal of Computer Technology & Applications, Vol 3 (1), 177-181 ISSN: 2229-6093, IJCTA, (2012).
14 Bharat Bhargava, Jibang Liu, Karthik Kumar, Yung-Hsiang Lu, "A Survey of Computation Offloading for Mobile Systems", Springer Science+ Business Media, LLC (2012).
15 Bu Sung Lee, Erwin Leonardi, George Goh, Markus Kirchberg, Verdi March, Yan Gu, "μcloud: towards a new paradigm of rich mobile applications, "Procedia Computer Science, vol. 5, pp. 618–624, (2011).
16 Ashwin Patti, Byung-Gon Chun, Mayur Naik, Petros Maniatis, Sunghwan Ihm, "CloneCloud: Elastic execution between mobile device and cloud", Proceedings of EuroSys, (2011).
17 Aruna Balasubramanian, Alec Wolman, Dae-ki Cho, Eduardo Cuervo, Paramvir Bahl, Ranveer Chandra, Stefan Saroiu, "MAUI: making smart phones last longer with code offload", Proceedings of the 8th international conference on Mobile systems, applications, and services (MobiSys'10), (2010).
18 Chiyoung Seo, Nenad Medvidovic, Sam Malek, "Estimating the energy consumption in pervasive Java-based systems", Proceedings of the Sixth Annual IEEE International Conference on Pervasive Computing and Communications, (2008).

Nancy Arya, Research Scholar
Department of Computer Science, Banasthali Vidyapeeth, Rajasthan, India
Dr. Sunita Chaudhary, Dr.S Taruna
Associate Professor, Department of Computer Science, IK Laxmipat University, Rajasthan, India.