An Adaptive Approach Towards Computation Offloading for Mobile Cloud Computing

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ABSTRACT

The widespread acceptability of mobile devices in present times have caused their applications to be increasingly rich in terms of the functionalities they provide to the end users. Such applications might be very prevalent among users but the execution results in dissipating many of the device end resources. Mobile cloud computing (MCC) has a solution to this problem by offloading certain parts of the application to cloud. At the first place, one might find computation offloading quite promising in terms of saving device end resources but eventually may result in being the other way around if performed in a static manner. Frequent changes in device end resources and computing environment variables may lead to a reduction in the efficiency of offloading techniques and even cause a drop in the quality of service for applications involving the use of real-time information. In order to overcome this problem, the authors propose an adaptive computation offloading framework for data stream applications wherein applications are partitioned dynamically followed by being offloaded depending upon the device end parameters, network conditions, and cloud resources. The article also talks about the proposed algorithm that depicts the workflow of the offloading model. The proposed model is simulated using the CloudSim simulator. In the end, the authors illustrate the working of the proposed system along with the simulated results.

KEYWORDS

Adaptive Code Offloading, Data Stream Applications, Mobile Cloud Computing, Mobile Computation Offloading

1. INTRODUCTION

Mobile cloud computing is an emerging concept, whose aim is to provide better services to mobile users without draining the resources of their devices and burdening them with an extra cost of data and energy. One of the biggest contributions of Mobile Cloud Computing was to resolve the problem pertaining to resource limitations of mobile devices. This was achieved through the concept of Mobile Computational Offloading (MCO), which involved the enhancement of computational capabilities of
resource-constrained devices by leveraging from the functionalities of cloud computing. Presently most applications fall under the offline category, where resources are local and data is downloaded from backend systems. In case of online applications data is mostly at user's perusal and web technologies serve as powerful alternatives to in-house applications. In both these cases to get optimum output system has to be adaptive to respond as per the changes in the mobile ecosystem. To achieve the desired outcome mobile devices can offload to any of the computational infrastructures be it the virtual machines or cloudlets depending upon the particular demand of an application (Khanna, 2016). Here the main concern is to maximize the performance of a smartphone application and conserve energy at the same time (Baker, 2015). However, mobile cloud computation works in a heterogeneous environment with each client having special demands while using different mobile devices. This requires dynamic partitioning and remote execution, for which some use Alfredo framework (Rellermeyer, 2008) to distribute application modules between a mobile device and the server. Same way R-OSGi (Rellermeyer, 2007) is utilized for interaction between virtual machines in some systems. Otherwise, weblets (Zhang, 2011) can be used for dividing an application into elastic components for dynamic execution. The weblets are not constrained to one programming language thus allowed to be used for a wider range of applications. Process migration is also an important aspect of allowing seamless transition of individual processes without affecting the performance.

In this paper, we have targeted mobile data stream applications and have tried to accommodate such applications on resource-constrained mobile devices by augmenting the execution of such applications and leveraging the cloud resources. We propose an adaptive computation offloading model for data stream applications. The model which we propose is based on the principles of dynamic code partitioning and works on thread level migration granularity. In our work, we have tried to maximize the performance of data stream applications by reducing the makespan and energy consumption (Baker, 2017) at the same time. Existing models assume the fact that the mobile user has access to an infinite number cloud resources whereas our proposed model makes offloading decisions by checking the availability of resources at the cloud-end.

Our remaining paper is organized into following sections: Section 4 presents our proposed model that talks through the System Architecture and Mathematical Model. Section 5 talks about the Algorithm for dynamic code partitioning and code offloading. Simulation and Results of the experiments carried out are presented in Section 7. Finally, Section 8 concludes the paper and suggests future work.

2. LITERATURE REVIEW

In present time smartphones come equipped with a lot of sensors, GPS, and connectivity to the internet or nearby devices which weren’t even available in computers in 90’s. Meanwhile, applications have become more complex, more space consuming and power hungry. The major challenge faced by smartphone makers is to make a sleek smartphone with a lot of battery power and an application developer creates an application which can compute more data in less time and with lot less power. However, the challenge is far bigger to be countered in a small mobile device. Mobile Cloud Computing tries to overcome the performance limitations of mobile devices by providing access to resource-rich clouds (Gupta, 2015). In MCC, mobile applications can use available virtualized cloud resources over a network, thus offering benefits to the cloud as well as network providers. Resource-hungry mobile applications can be easily executed on cloud servers. Architectural components of MCC include a mobile device, cloud, and network. A network is responsible for the communication between mobile user and cloud. Network latency and low bandwidth may obstruct the objectives of MCC. Good network characteristics can bring benefits of MCC to more and more users. The concept of virtualization and thus the use of VMs help in augmenting the execution of mobile applications onto the cloud with ample resources like CPU core, memory, and storage. To transfer an application
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