An Innovative Genetic Method for Thin-Thick Client Collaboration to Optimize Task Scheduling in Mobile Cloud Computing

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Abstract: Mobile Cloud Computing (MCC) allows the shift of local heavy computing tasks and data storage from mobile devices to the Internet, i.e. to a bunch of virtualized servers running on cloud provider networks to deal with constraints related to the performance (e.g., battery life, storage, and network connectivity), environment (e.g., heterogeneity, scalability, and availability). However, it still suffers from lots of inherent problems, especially the limited processing speed of thin client devices such as smart phones, tablets, iWatch, Google glass, etc. Recently, most of the research studies try to solve this problem, but are not yet efficient in providing seamless computing experience. In this paper, we introduce a novel comprehensive architecture that involves the conventional desktop or laptop computers, known as thick clients, and thin clients, to bring better cloud access, and further present a novel genetic method for an effective task scheduling to reduce the processing time in cloud service while still considering network contention and customer payment. Experiment results prove that our method can improve task scheduling efficiency and is better cost-effective than other studies.

Keywords: Task scheduling; thin-thick client; cloud computing; offloading;

1. Introduction

We have seen an explosion of smart phones in this era, when mobile devices are becoming more and more prominent in personalized and business computing. Proportional to that are the increasing demands for mobile and service application from users, which may more or less require processing capabilities beyond what could be offered by even the most powerful smart phones [3]. Fortunately, Cloud Computing, with virtually unlimited resource and service provision, has arrived and is anticipated to boost up the power of the so-called thin clients such as smart phones, tablets, or even the Google cutting-edge invention, Google glass [10], iWatch [15] and extend the capability of mobile computing. While the integration of those 2 computing platforms, known as Mobile Cloud Computing, seems promising, it is however insufficient and vulnerable to the inherent problems of the thin devices: unstable cloud access, low network connectivity, especially the weak processing capacity. These shortcomings may cause service quality degradation, especially the processing time.

In recognition of this weakness, lots of dedicated research work have been carried out to find ways to improve it. In [1], Frank Siegemund, Christian Floerkemeier and Harald Vogt argue that it is possible for smart objects (i.e. smart phones, tablets) to exploit computing resources from nearby nodes to enhance their own processing power. In a similar work, the author presents guidelines for a framework to create the virtual mobile cloud computing providers [2]. This framework is able to create instant on-the-move connection by making use of nearby thin clients, thus avoiding the need to connect to infrastructure-based clouds. Findings from these works, unfortunately, are not sufficient to thoroughly eliminate the problems of mobile thin client normally coming up with limited on-board computing, information storage capabilities, battery life and unpredictable network connectivity (as discussed above). Thick clients, on the other hand, usually offer much better hardware capacity as well as being backed by high-speed Internet connection. Some latest generations of smartphones, though, can also be considered thick clients as they are resourceful enough, thanks to their multi-core CPU, large (built-in and extended) memory and especially the LTE connection. It is thus comprehensible that thin clients could be coupled with thick clients to achieve a desirable access to cloud [6]. However, one of the main issues in [6] is the task scheduling, which decides the processing time, QoS and user experience. Therefore, the main technical contribution of this paper, based on the idea in [6], is to propose an extended work with the application of genetic algorithm in order to utilize the collaboration between the thin-thick clients and cloud network in task scheduling. In so doing, we expect that the processing time of the cloud system can be reduced, accordingly improve QoS and user experience. Particularly, in order to make the service quality able to come up to user’s expectation, our method considers not only the network contention but also the money cost charged to costumers. Thorough experiments have been carried out and the results...