모바일 장치와 클라우드 사이 거리의 영향 측정에 대한 연구

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A Design of Measuring impact of Distance between a mobile device and Cloudlet

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요 약

최근, 모바일 장치는 컴퓨터와 비슷한 기능을 갖추고 있다. 그러나, 모바일 장치는 낮은 처리 능력, 제한된 메모리, 예측할 수 없는 연결 및 제한된 배터리 수명 등 과 같은 제약으로 인해 제한된 리소스를 가지고 있다. 모바일 장치의 능력을 향상시키기 위한 아이디어는 컴퓨팅 인프라 모바일 장치로부터 부하를 이동하는 클라우드 컴퓨팅 및 가상화 기술을 사용하는 것이다. 이러한 기술은 모바일 장치에서 resource-rich cloud 또는 서버로 많이 계산되는 리소스를 이동하는 기술로 구성된다. 이러한 기술에 대한 목표를 달성하기 위하여, 연구자들은 모바일 클라우드 애플리케이션 모델을 설계를 하고 있었다. 이 논문에서 우리는 cloudlet architecture에 대해 강조하고, 그 방법론과 cloudlet과 모바일 장치사이에서 영향 측정에 대해 설계에 대해 연구한다.

ABSTRACT

In recent years, mobile devices are equipped with functionalities comparable to those computers. However, mobile devices have limited resources due to constraints, such as low processing power, limited memory, unpredictable connectivity, and limited battery life. To enhance the capacity of mobile devices, an interesting idea is to use cloud computing and virtualization techniques to shift the workload from mobile devices to a computational infrastructure. Those techniques consist of migrating resource-intensive computations from a mobile device to the resource-rich cloud, or server (called nearby infrastructure). In order to achieve their goals, researchers designed mobile cloud applications models (examples: CloneCloud, Cloudlet, and Weblet). In this paper, we want to highlight on cloudlet architecture (nearby infrastructure with mobile device), its methodology and discuss about the impact of distance between cloudlet and mobile device in our work design.

Keyword

mobile cloud computing, cloudlet, Offloading computation, mobile application model

Ⅰ. Introduction

Cloud computing and mobile applications have been the leading technology trends in recent years. Mobiles devices such as smart phones and tablets have become an essential part of our lives, because of their powerful capabilities. In spite of the benefits provided by the mobile devices, and the way they make the life easier, they have many weaknesses such as limited battery life-time, limited processing capabilities and limited storage capacity. One solution to overcome these limitations is to integrate Cloud Computing technology with mobile devices to produce what is called Mobile Cloud Computing (MCC) [1]. Rather than running applications locally and directly requesting data from content providers, a mobile device can offload parts of their workload to the cloud, taking advantage of the abundant cloud resources to help gather, store, and process data for the mobile device [2]. MCC has recently become one of the most important and hottest research topics; because it integrates the new smart phones with the cloud computing technologies. In general, to make the smartphones energy efficient and computationally capable, major hardware and software level changes are needed, which requires the developers and manufacturers to work together [3]. Due to size-constraints, hardware level changes alone may not enable smartphones to achieve true unlimited computational power. Therefore, software-level changes are more effective, where computation is performed on remote resources with partial support of a smartphone's hardware [4]. Moreover, despite the fast development of hardware technology, it is still difficult to support computation-intensive applications (e.g., image processing, augmented reality) on mobile devices, hindering developers from bringing richer experiences and complex applications to mobile users [5]. Therefore, smartphones require an application model that supports computation offloading and optimized for mobile cloud environment in terms of heterogeneity, context awareness, application partitioning overhead, network data cost, bandwidth, and energy consumption [6].

Ⅱ. Overview of Application models for mobile cloud computing

The mobile cloud application models are designed to achieve a particular objective, such as executing applications that have insufficient resources for local execution, enhancing applications performance (in terms of computation time), or achieving energy efficiency on mobile devices[7]. Some of the proposed applications models have been discussed in literature review such as: 1) CloneCloud: CloneCloud [8], [9] is a system which automatically convert applications of the mobile devices by partially offload it into the virtual clone (phones) present in the cloud. The VM creates a new process state and overlays the received information, followed by execution of the clone. On completion of the execution, the process state of the clones' application is sent to the smartphone, where the process state is reintegrated into the smartphones' application and the application comes out of a sleep state. 2) WebLet [10]: This model is based on elastic applications technique, where a single elastic application is partitioned into multiple components called weblets. A weblet can be defined as an independent functional unit of an application that can compute, store, and communicate while keeping its execution location transparent. 3) ThinkAir: ThinkAir [11] supports method-level offloading to a smartphone clone executing in the cloud. It is designed to achieve the desired QoS (quality of service) by executing multiple clones of the smartphone in parallel.

Ⅲ. Cloudlet application model

A cloudlet is a new architectural element that arises from the convergence of mobile computing and cloud computing. It represents the middle tier of a 3-tier hierarchy: mobile device - cloudlet -cloud [12]. A cloudlet can be viewed as a "data center in a box" whose goal is to "bring the cloud closer". A cloudlet has four key attributes: 1.only soft state: It is does not have any hard state, but may contain cached state from the cloud. 2. Powerful, well-connected and safe: It possesses sufficient compute power (i.e., CPU, RAM, etc.) to offload resource-intensive computations from one or more mobile devices. 3. Close at hand: It is logically proximate to the associated mobile devices. "Logical proximity" is defined as low end-to-end latency and high bandwidth (e.g., one-hop Wi-Fi). 4.builds on standard cloud technology: It encapsulates offload code from mobile devices in virtual machines (VMs).

3.1 cloudlet: physical architecture

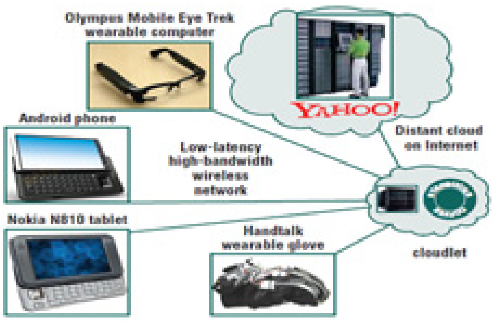

Fig 1. cloulet concept

Rather than relying on a distant "cloud," the resource poverty of a mobile device can be addressed by using a nearby resource-rich "cloudlet". The need for real-time interactive response can be met by low latency, one-hop, and high-bandwidth wireless access to the cloudlet [13]. The mobile device functions as a thin client, with all significant computation occurring in the nearby cloudlet. If a mobile device user moves away from the cloudlet he is currently using, interactive response will degrade as the logical network distance increases. To address this effect of mobility, the offloaded services on the first cloudlet need to be transferred to the second cloudlet maintaining end-to-end network quality.

3.2 computation offloading cloudlet system

Cloudlet is discoverable by mobile devices and is virtual-machine based to promote flexibility, mobility, scalability and elasticity [14].

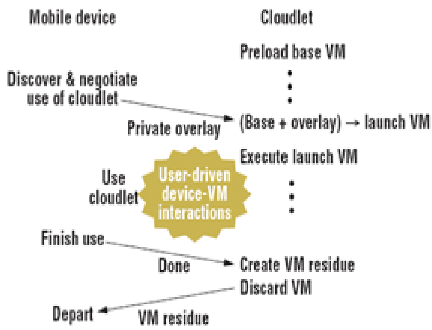

Fig 2. dynamic VM Synthesis timeline approach

Moreover, the mobile devices rely on low-latency, one-hop cloudlet that is accessible via a Wi-Fi connection. For this approach (Dynamic VM Synthesis), a small VM overlay is delivered by a mobile device to cloudlet infrastructure that already possesses the base VM from which this overlay was derived. The infrastructure applies the overlay to the base to derive the launch VM, which starts execution in the precise state from which the overlay was derived [15].

IV. Work Design

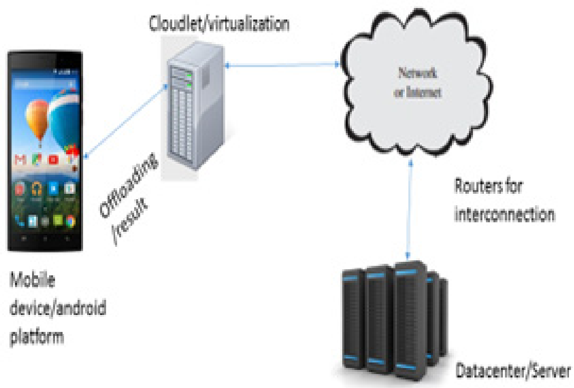

Fig 3. Work design architecture

Our design will be done in two steps namely implementation of Cloudlet infrastructure and programming on android platform in order to measure the impact of distance between cloudlet and associated mobile devices. Cloudlet and mobile devices must be close but there no idea in which range. In our experiments, we will consider different distances between cloudlet and mobile device in order to make a conclusion of an acceptable range of distances to benefit highly cloudlet' s power.

V. Conclusion

Mobile devices have very limited resources, being their main weak points computing power, storage space, and battery life. To augment computing power and improve battery life, many of mobile applications models have developed so far by some researchers. Among them, Cloudlet which will be used in our design have been detailed in order to use it in our implementation. Our following work will be the implantation of our system on which our experiments will rely.

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