Cloudlets: At the Leading Edge of Cloud-Mobile Convergence

Invited Keynote Abstract

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Abstract

Since the dawn of mobile computing two decades ago, the unique constraints of mobility have shaped the software architectures of systems. We now stand at the threshold of the next major transformation in computing: one in which the rich sensing and interaction capabilities of mobile devices are seamlessly fused with compute-intensive and data-intensive processing in the cloud. This heralds a new genre of software that augments human perception and cognition in a mobile context.

A major obstacle to realizing this vision is the large and variable end-to-end WAN latency between mobile device and cloud, and the possibility of WAN disruptions. Cloudlets have emerged as an architectural solution to this problem. A cloudlet represents the middle tier of a 3-tier hierarchy: mobile device – cloudlet – cloud, and can be viewed as a "data center in a box" whose goal is to "bring the cloud closer". A cloudlet-based hardware/software ecosystem inspires futuristic visions such as cognitive assistance for attention-challenged mobile users, scalable crowd-sourcing of first-person video, and ubiquitous mobile access to one's legacy world. Realizing these visions will require many technical challenges to be overcome. It will also require us to rethink a wide range of issues in areas such as privacy, software licensing, and business models.

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Further Reading

The Elijah project web site at `http://elijah.cs.cmu.edu` is a useful resource for information about cloudlets. The original rationale for VM-based cloudlets was presented in a 2009 paper [4]. This paper introduced the term *dynamic VM synthesis,* and showed initial results on its performance. An earlier 2008 paper by Wolbach et al [8] foreshadowed this concept, but referred to it as "transient customization." Experimental validation of the need for cloudlet proximity was provided by Clinch et al [1] and Ha et al [2]. Optimizations to speed up dynamic VM synthesis by nearly an order of magnitude were described by Ha et al [3], yielding times of 10–15 seconds from cloudlet association to first response. A bandwidth-centric case for cloudlets is made by Simoens et al in their recent GigaSight work on scalable cloud-sourcing of video from mobile devics [7]. From a very different viewpoint, two recent papers [5, 6] explain how cloudlets can improve the availability of cloud-based services in situations where network connectivity is fragile.

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