Gabriel Wearable Cognitive Assistance using cloudlets

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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.   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:

- **only soft state:**   It is does not have any hard state, but may contain cached state from the cloud. It may also buffer data originating from a mobile device (such as video or photographs) en route to safety in the cloud. The avoidance of hard state means that each cloudlet adds close to zero management burden after installation: it is entirely self-managing.

- **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. It has excellent connectivity to the cloud (typically a wired Internet connection) and is not limited by finite battery life (i.e., it is plugged into a power outlet).   Its integrity as a computing platform is assumed; in a production-quality implementation this will have to be enforced through some combination of tamper-resistance, surveillance, and run-time attestation.

- **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).   Often, logical proximity implies physical proximity. However, because of "last mile" effects, the inverse may not be true: physical proximity may not imply logical proximity.

- **builds on standard cloud technology:** It encapsulates offload code from mobile devices in virtual machines (VMs), and thus resembles classic cloud infrastructure such as Amazon EC2 and OpenStack. In addition, each cloudlet has functionality that is specific to its cloudlet role.

For background information and rationale for cloudlets, see "The Case for VM-based Cloudlets in Mobile Computing"   As the paper explains, cloudlets are the enabling technology for a new genre of resource-intensive but latency-sensitive mobile applications that will emerge in the future. These include new cognitive assistance applications that will seamlessly enhance a user's ability to interact with the real world around him or her. Here is an early thought piece on augmenting cognition and here is a cool YouTube video of the very first wearable cognitive assistance application that we have built.

"Bringing the cloud closer" also improves the survivability of mobile computing in hostile environments such as military applications and disaster recovery. Easily-disrupted

critical dependence on a distant cloud is replaced by dependence on a nearby cloudlet and best-effort synchronization with the distant cloud.   The paper "The Role of Cloudlets in Hostile Environments" explores these issues.

The impact of high offload latency on mobile user experience can be seen in these YouTube videos.

The name "Elijah" was inspired by the earliest mention of cloudlets in the literature. Gabriel is an angel who looks out for you.

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