Aura: Distraction-Free Ubiquitous Computing

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Technological trends are leading to a world in which computing is all around us – in our cars, our kitchens, our offices, our phones, and even our clothes. In this world we can expect to see an explosion of computational devices, services, and information at our disposal. While this is an undeniable opportunity, currently we are ill-prepared to deal with its implications.

To take a simple example: Today I can easily afford to have 10 PCs in my office. But what can I do with them? Simply keeping them synchronized would be a nightmare. There are few, if any, applications that can exploit them simultaneously. And even if I could harness them all at once, the effort of configuring all of that software, ensuring version compatibility, starting it up, and stopping it in a consistent fashion would be painful. Furthermore, that equipment would not be usable by me in all of the other settings away from my office. Put simply, there is a serious mismatch between the availability of computing resources and our ability to exploit them effectively.

The root of the problem is that the most precious resource in a computer system is no longer its processor, memory, disk or network. Rather, it is a resource not subject to Moore's law: user attention. Today's systems distract a user in many explicit and implicit ways, thereby reducing his effectiveness. Unless we find ways to make technology more "invisible" we will see a widening gap between technological capability and usefulness.

At CMU we are addressing this problem in a new research effort called Project Aura. Aura's goal is to provide each user with an invisible halo of computing and information services that persists regardless of location, and that spans wearable, handheld, desktop, and infrastructure computers. As the user moves from one location to another, and as resources come and go, the system adapts, providing the user with continuous, self-configuring, optimal access to data and computation.

To achieve this goal, Project Aura is attempting to rethink system design, focusing on integrating two broad concepts across all system levels. First, it uses proactivity, or the ability of a system layer to act in anticipation of requests by a higher layer. This is in contrast to today's systems, where each layer is reactive to the layer above it. Second, Aura is self-tuning: layers adapt by observing the demands made on them and adjusting their performance and resource usage characteristics to match demand. This is in contrast to today's systems, where the behavior of a system layer is relatively static.