Mobile Computing: the Next Decade and Beyond

Mahadev Satyanarayanan
School of Computer Science
Carnegie Mellon University

Abstract

"Information at your fingertips anywhere, anytime" has been the driving vision of mobile computing for the past two decades. Through relentless pursuit of this vision, spurring innovations in wireless technology, energy-efficient portable hardware and adaptive software, we have now largely attained this goal. Ubiquitous email and Web access is a reality that is experienced by millions of users worldwide through their BlackBerries, iPhones, Windows Phone, and other portable devices.

What will inspire our research in mobile computing over the next decade and beyond? We observe that our future is being shaped by two different tectonic forces, each with the potential to radically change the mobile computing landscape.   One force is the *emergence of mobile devices as rich sensors,* a role that may soon dominate their current function as communication devices and information appliances.   We use the term "rich" to connote the depth and complexity about the real world that is recorded, typically through image capture. This is in contrast to simple scalar data that has typically been the focus of the sensor network community in the context of energy-impoverished "smart-dust" sensors.   The other force is the *convergence of mobile computing and cloud computing.* This will enable the emergence of new near-real-time applications that are no longer limited by energy or computational constraints that are inherent to mobility.   The intersection of these immense forces in the next decade will lead to many new research challenges and business opportunities.

Bio

Satya is an experimental computer scientist who has pioneered research in mobile and pervasive computing. One example of his work is the *Coda File System,* which supports distributed file access in low-bandwidth and intermittent wireless networks through disconnected and bandwidth-adaptive operation. The Coda concepts of hoarding, reintegration and application-specific conflict resolution are seen in the hotsync capability of mobile devices today. Key ideas from Coda were also incorporated by Microsoft into the IntelliMirror component of Windows 2000 and the Cached Exchange Mode of Outlook 2003. Other examples of Satya's work include *Odyssey* (which explored operating system support for application-aware adaptation to overcome resource limitations in mobile computing) and the *Internet Suspend/Resume* system (a hands-free approach to mobile computing that leverages virtual machine technology).   Satya is a co-inventor of many technologies central to mobile and pervasive computing, such as cyber foraging, data staging, lookaside caching, and translucent caching.   He is also a co-inventor of the *Diamond* approach to interactive content search of non-text data (such as smartphone photos) in bandwidth-limited environments. Early in his career, Satya was a principal architect and implementer of the *Andrew File System (AFS)* which pioneered scalable file caching and enterprise-scale information sharing. AFS was commercialized by IBM, is in widespread use today as *OpenAFS*, and has heavily influenced the *NFS v4* network file system protocol standard. Satya is the Carnegie Group Professor of Computer Science at Carnegie

Mellon University.   He received the PhD in Computer Science from Carnegie Mellon, and Bachelor's and Master's degrees from the Indian Institute of Technology, Madras. He is a Fellow of the ACM and the IEEE. He was the founding Editor-in-Chief of *IEEE Pervasive Computing* and the founding program chair of the HotMobile workshop series.