The importance of pervasive computing is rapidly increasing with the current trend toward universal presence of mobile computing, computer networks, and wireless communications in everyday life. In the last decade, there has been a dramatic increase in the use of companion devices and embedded computing devices. For example, wirelessly connected organizers and smart phones are becoming popular, and digital computing in some form is now an integral part of numerous everyday appliances. This has led to a change in the way we perceive computing and computers. Computers are no longer standalone special-purpose machines to be used by experts; rather, they are ubiquitously present in a networked environment to serve myriad needs of everyday life. The change in our perception of computing and computing devices, and their ever increasing presence in our everyday life is the subject of the new field known as pervasive computing. The word pervasive means having power to spread throughout. Pervasive computing is an environment where people interact with various companion, embedded, or invisible computers. It essentially means to enable networked devices to be aware of their surroundings and peers, and to be capable to provide services to and use services from peers effectively. Pervasive computing encompasses many different technologies, such as mobile computing and wearable computers, and is the enabling technology for such applications as e-commerce and connected home. Recently, many research groups in companies and universities have proposed several solutions toward improving the state of the art in pervasive computing. There are many initiatives to investigate issues such as user interfaces, collaborative environments, new computing paradigms, information presentation, and e-commerce. The purpose of the special issue was to bring together the researchers and practitioners working on diverse aspects of this important emerging area in order to identify current status, fundamental issues, future problems, and applications. We present one invited article and eight other articles selected from 24 outstanding papers that were submitted. Certainly, we couldn't cover all aspects of pervasive computing; we have classified the selected articles in three categories: networking, system/middleware, and applications.

Professor M. Satyanarayanan of Carnegie Mellon University, in his invited article of this special issue, "discusses the challenges in computer systems research posed by the emerging field of pervasive computing." He outlines a progression from distributed computing to mobile computing to pervasive computing. He observes that key issues in distributed computing include remote communication, fault tolerance, high availability, remote information access, and distributed security. Issues in mobile computing are a cross product of the above issues with new issues such as mobile networking, mobile information access, adaptive applications, energy awareness, and location sensitivity. Finally, issues in pervasive computing are a cross product of issues in mobile computing and further new issues such as smart spaces, invisibility, localized scalability, and uneven conditioning of environments.

The next two articles deal with different networking issues in pervasive computing. The first article, "PiNet: Wireless Connectivity for Organizational Information Access Using Lightweight Handheld Devices" by Carmeli et al., describes wireless connectivity architecture to support access to organizational information in a mass-market-type application with thousands of users simultaneously accessing the information using a low-cost low-power device. This article addresses the location, energy, and localized scaling issues. The second article, by Misra et al., "Autoconfiguration, Registration, and Mobility Management for Pervasive Computing," addresses issues related to the network, device, and application heterogeneity commonplace in pervasive systems. The authors motivate the need and show methods for efficient autoconfiguration, registration, and mobility management to support diverse environments and applications. This article addresses issues related to masking uneven conditioning, mentioned in the article by Satyanarayanan.

Our definition of systems/middleware included broad topics such as data management, service discovery, system architecture, and information models. The article "Expressing User Profiles in Data Recharging" by Cherniack et al. addresses mobile information access issues by providing an automatic capability whereby data on a user device is "recharged" from time to time in a personalized manner based on user profiles. One key to enabling smart spaces is the ability to discover "close-by" services/devices in a manner that conserves power and bandwidth. The "Service Discovery in DEAPspace" article by Michael Nidd presents a discovery algorithm targeted for wireless, ad hoc, single-hop networks, that enables devices to efficiently detect neighboring devices, and exchange configuration and service information with such devices. The other two articles contribute to better integration of real-world entities with the virtual information world. They address a number of issues including smart spaces, localized scalability, location awareness, and mobile information access. The article "Uniform Web Presence Architecture for People, Places, and Things" by Debay et al. defines horizontal and uniform software architecture for building a Web presence (virtual representation) of real-world entities such as people, places, and things. The architecture enables dynamic generation of Web contents based on user context, security preferences, and the user's relationship with other Web presences. The article "Sensor Information Networking Archi-
tecture and Applications" by Sriopathornphat et al., presents an information model for sensors that enables querying, monitoring, and tasking sensor networks using a declarative programming approach based on SQL.

One of the first issues (and perhaps the hardest one) pervasive computing has to deal with is that of invisibility. Ideally, pervasive computing should disappear in the fabric of our surroundings and daily lives. A user should not know that a simple action he/she invokes very naturally causes a large number of finely orchestrated things to happen behind the scenes. Achieving invisibility will require tremendous progress in user interfaces, context awareness, and other technologies. The two articles we selected in the applications class only begin to address some of the issues. The article “Designing an E-Grocery Application for a Palm Computer: Usability and Interface Issues” by Bellamy et al. is an article about experience designing an everyday application on a pervasive device. The article presents the evolution of the application design using feedback from 200 shoppers and describes the process that alternated design activities with formative field evaluations. The article “How to Build Smart Appliances” by Albert Schmidt et al. presents a holistic methodology in building smart consumer appliances that involve understanding contextual sensor data and context-aware applications. The article discusses the relation between a real-world situation and data read by sensors, and converting sensory data to cues and then to contexts as a foundation to build context-aware applications.

Clearly, the articles in this section can only cover a selection of the issues implied in the invited article by M. Satyanarayanan. We hope, however, that the set of articles gives the reader a broad appreciation of the challenges in pervasive computing and the progress the research community is making in addressing some of them. The guest editors are grateful to the Editor-in-Chief for the opportunity to put together this exciting special issue, and we hope the readers enjoy it. We also thank the various reviewers who greatly helped us in selecting the best articles. We hope you will enjoy this special issue as much as we enjoyed putting it together.

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