The Future of Personal Area Networks in a Ubiquitous Computing World

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ABSTRACT

In the future world of ubiquitous computing, wireless devices will be everywhere. Personal area networks (PANs) will enable communications between devices both embedded in the environment and mobile on vehicles and persons. This research determines the future prospects of PANs by examining (a) criteria that will lead to success, (b) barriers to implementation, and (c) key applications. An initial set of issues in each of these areas is identified from the literature. The Delphi Method is used to determine what experts believe what are the most important success criteria, barriers, and applications. Critical success factors that will determine the future of personal area networks include reliability of connections, interoperability, and usability. Important barriers that may inhibit the deployment of PAN are security, interference and coexistence, and regulation and standards. Key applications for PAN success include monitoring, healthcare, and smart things.

Keywords: Personal Area Networks, Ubiquitous Computing, Pervasive Computing, Success Criteria, Implementation Barriers, Killer Application, Delphi Method

INTRODUCTION

The importance of this study lies in the assumption that in the not too distant future, ubiquitous computing will be part of everyday life. This ubiquitous computing future will depend on device-to-device communication, through personal area networks, to allow the environment and everyday things to respond to an individual’s needs or operating requirements. Insight into ubiquitous computing is available in Mostefaoui, Maamar, and Giaglis (2008), Weiser (1991), and especially Greenfield (2006). Defining the prospects for personal area networks in this ubiquitous computing world is the primary focus of this study.

Most studies define a PAN according to its short-range characteristic. For example, a PAN typically covers a few meters around a user’s location and provides the capacity to communicate and synchronize a wireless device to other computing devices (Boukerche, 2005; Zhang & Chen, 2004). Key characteristics of PANs are low-power consumption, frequent make-and-break connections, varied data rates, varied network topologies, and low produc-

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tion costs (Boukerche, 2005; Morrow, 2004; Prasad, 2006).

For the most part, PAN technologies (e.g. infrared, Bluetooth, ZigBee, Ultra-wideband (UWB)) have been developed for unobtrusive computing devices that can be worn by individuals to enhance the ability to perform productive work as well as provide entertainment (Braley, Gifford, & Heile, 2000). PANs are likely to become commonplace in the near future because a number of mobile smart devices such as PDAs and sophisticated mobile phones are already available and the trend is set to continue with more devices becoming wirelessly connectable and communicable (Sze-Toh & Yow, 2002).

The primary research question of this study is what are the future prospects for personal area networks in a ubiquitous computing world? The sub-research questions are:

- What are the key criteria or combination of criteria that will determine the future success of personal area networks?
- What barriers will be associated with PAN implementations?
- Which applications or application areas are likely to be the most important in determining the success of personal area networks?

These questions are addressed through a predictive research methodology known as the Delphi Method. In this study, a panel of PAN experts are presented with a list of success criteria, implementation barriers, and key applications that are discovered in a review of the literature. In the first round of the Delphi Method the panelists vote to determine which of these issues are important enough to be included in round two and they justify their decisions with comments. The panelists also nominate any additional criteria, barriers and applications not found in the literature. In the second round, the panelists first vote on the nominated issues from the first round – to retain these or not. Then all issues are rated on a Likert scale to determine their importance to the future of personal area networks, again with comments to justify their rating. In a third round, the results of round two are presented to the panel and panelists are asked to re-consider their rating in light of the group mean and comments, in order to try to achieve a consensus.

**LITERATURE REVIEW**

The principal purpose of the literature review in this study was to identify the main success criteria, barriers to implementation, and key applications in the literature for consideration by a panel of experts in round one of the Delphi Method. The descriptions in this section represent only a small part of what was discovered in the literature and presented to the panel. Additional detail can be obtained from the authors.

**Success Criteria for Personal Area Networks**

Based on a review of the business-oriented literature related to PANs, the following 11 criteria were identified as potentially critical to the success of PANs:

- BlueStar architecture
- Consumption types
- Frequency switching
- Interoperability
- Power management
- Range
- Sleep/wakeup scheduling
- Speed gap
- Transmission speed
- Widespread deployment
- Wireless power transfer

At the end of the first round of the Delphi Method, the panel of PAN experts considered the following criteria to be inappropriate or not worthy of further consideration: BlueStar architecture, consumption types, range, sleep/wakeup scheduling, speed gap, and wireless power transfer. The remaining five criteria are briefly described below.
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