Chapter 13
Dynamic Ambient Networks with Middleware

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ABSTRACT

Ambient Intelligence is the concept that technology will become a part of everyday living and assist users in multiple tasks. It is a combination and further development of ubiquitous computation, pervasive computation, and multimedia. The technology is sensitive to the actions of humans and it can interact with the human or adjust the surroundings to suit the needs of the users dynamically. All of this is made possible by embedding sensors and computing components inconspicuously into human surroundings. This paper discusses the middleware needed for dynamic ambient intelligence networks and the ambient intelligence network architecture. The bottom-up middleware approach for ambient intelligence is important so the lower layers of all ambient intelligence networks are interchangeable and compatible with other ambient intelligence components. This approach also allows components to be programmed to be compatible with multiple ambient intelligence networks. The network architecture discussed in this paper allows for dynamic networking capabilities for minimal interruptions with changes in computer components.

INTRODUCTION

Ambient intelligence is ubiquitous, flexible, human-centered computer systems. The components are embedded into human environments to enhance life in a way natural to humans (Anastasopoulos et al., 2005). Ambient intelligence is “a condition of an environment that we are in the process of creating” (Riva et al., 2005). The technology becomes a part of everyday living and can assist the users in many everyday tasks, such as temperature control, kitchen inventory,
smart shopping, or security alarms and controls. Technology is supposed to be hidden from the human’s eyes and intuitively to use.

Ambient intelligence networks can interact with humans or adjust the surroundings to suit the needs of the user dynamically. For example, an ambient network in a home can be programmed to lower the temperature of the house during the winter to save energy. However, the network will recognize when a user enters the network and will adjust the temperature settings to make the house more comfortable.

In order for dynamic use of ambient networks, the hardware and middleware structures must be compatible so devices can be found and used by different networks. The basic network architecture and middleware services must be universally compatible and dynamic so devices can leave and enter the network freely and use the services provided by the network when needed. The basic structure of the services provided by the network must be similar so the devices can be programmed to utilize the services of any ambient network.

This chapter discusses a bottom-up structure for middleware and hardware architecture for ambient networks. The bottom-up middleware approach for ambient intelligence is important so that the lower layers of all ambient intelligence networks are interchangeable and compatible with other ambient intelligence components. This approach also allows components to be programmed to be compatible with multiple ambient intelligence networks.

The middleware structure provides a logical view of the services an ambient intelligence network is supposed to provide (Grace, Blair and Samuel, 2003). The middleware services must be used universally to ensure compatibility across ambient intelligence networks and various hardware devices. The middleware services must be able to communicate, distribute events or actions to other components, lookup or search for components, find similar components, log sensor data, and find the location of components and users in a network.

This chapter also discusses general requirements and hardware topology needed to make ambient intelligence networks universally compatible. The four categories of hardware topology are discussed, which must be accounted for in ambient networks. The four major categories of hardware are fixed nodes, portable nodes, sensor/actuator nodes, and device nodes. The network architecture discussed in this chapter allows for dynamic networking capabilities for minimal interruptions with changes in computer components.

**BACKGROUND**

Ambient intelligence is a further development of the field of ubiquitous computation, pervasive computation, and multimedia. Ambient intelligence research covers complete platforms, development methods, and many other features (Vasilakos and Pedrycz, 2006; Bartelt et al., 2005; Funk, Kuhmunch and Niedermeier, 2005). The research field of ambient intelligence starts to spread rapidly and first applications are on their way (Noguchi, Mori and Sato, 2003; Jammes and Smit, 2005; Kahn, Katz and Pister, 2000; Kirk and Newmarch, 2005). For example, an intelligent refrigerator communicates to a consumer in the supermarket on which food is needed to cook a certain dish. The ambient intelligent system consists of many services: an online shop which provides cooking recipes, networking which enables communication between different components, RFID (Radio-frequency identification) readers in the refrigerator which are used to search for the right food and guide the consumer to the corresponding locations. The consumer can simply interact with a monitor on his shopping car (Lugmayr, 2006) to accomplish the smart shopping process.

There are many different definition of ambient intelligence based on the different perspectives.
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