Chapter 1.20
Leveraging Pervasive and Ubiquitous Service Computing

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ABSTRACT

The advancement of technologies to connect people and objects anywhere has provided many opportunities for enterprises. This chapter will review the different wireless networking technologies and mobile devices that have been developed, and discuss how they can help organizations better bridge the gap between their employees or customers and the information they need. The chapter will also discuss the promising application areas and human-computer interaction modes in the pervasive computing world, and propose a service-oriented architecture to better support such applications and interactions.

INTRODUCTION

With the advancement of computing and communications technologies, people do not have to sit in front of Internet-ready computers to enjoy the benefit of information access and processing. Pervasive computing, or ubiquitous computing, refers to the use of wireless and/or mobile devices to provide users access to information or applications while the users are on the go. These mobile devices can be carried by the users, or embedded in the environment. In either case, these devices are connected, most likely through a wireless network, to the Internet or a local area network (LAN).

Mobile technologies come in a large variety and are ever changing. In order to gain the business value of pervasive computing, and at the same time keep the supporting cost under control, it is important to develop an architecture solution. A service-oriented architecture (SOA) would allow an enterprise to easily provision functions to be accessible by certain types of pervasive channels. A service-oriented architecture would also make it possible to quickly integrate data generated by pervasive devices and make them available in the form of an information service.

In this chapter, we will first look at the communication networks and mobile devices that create the various information-access and information-generation touch points in a pervasive

computing environment. Then we will discuss the applications and interaction models for pervasive computing. Finally, we will describe a service-oriented architecture that an enterprise can adopt in order to effectively and efficiently support pervasive computing.

MOBILE COMMUNICATION NETWORKS

Mobile communication technologies range from personal area networks (PANs; a range of about 10 meters) and local area networks (a range of about 100 meters) to wide area networks (WANs; a few kilometers). From a network-topology perspective, most networks are based on a client-server model. A few are based on the peer-to-peer model.

Wireless PANs

A wireless personal area network allows the different devices that a person uses around a cubicle, room, or house to be connected wirelessly. Such devices may include the computer, personal digital assistants (PDAs), cell phone, printer, and so forth.

Bluetooth is a global de facto standard for wireless connectivity (Bluetooth SIG, 2005). The technology is named after the 10th-century Danish King Harald, who united Denmark and Norway and traveled extensively.

HomeRF is an early technology for wireless home networking, first marketed in 2000.

The Institute of Electrical Engineers (IEEE) 802.15 wireless-PAN effort (IEEE, 2005a) focuses on the development of common standards for personal area networks or short-distance wireless networks. One technology out of this effort is ZigBee, which is based on the IEEE 802.15.4 standard.

ZigBee is a low-cost, low-power-consumption, wireless communication-standard proposal (ZigBee Alliance, 2005). Formerly known as FireFly, ZigBee is being developed as the streamlined version of HomeRF. A streamlined version would allow most of the functionality with less integration and compatibility issues.

ZigBee's topology allows as many as 250 nodes per network, making the standard ideal for industrial applications. Radio-frequency-based ZigBee is positioned to eventually replace infrared links. To achieve low power consumption, ZigBee designates one of its devices to take on the coordinator role. The coordinator is charged with waking up other devices on the network that are in a sleep mode, moments before packets are sent to them. ZigBee also allows coordinators to talk to one another wirelessly. This will allow for opportunities for wireless sensors to continuously communicate with other sensors and to a centralized system.

For enterprise computing, the wireless PANs are within the corporate firewall. They do not

Table 1. Summary of the wireless PANs

Technology	Radio Frequency	Maximum Distance	Data Capacity
Bluetooth	2.4 GHz	10 meters	721 Kbps
HomeRF	2.4 GHz	50 meters	0.4-10 Mbps, depending on distance
ZigBee	2.4 GHz	75 meters	220 Kbps