Chapter IX
Towards Easy-to-Use, Safe, and Secure Wireless Medical Body Sensor Networks

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ABSTRACT

Wireless body sensor networks (BSNs) are an indispensable building stone for any pervasive healthcare system. Although suitable wireless technologies are available and standardization dedicated to BSN communication has been initiated, the authors identify key challenges in the areas of easy-of-use, safety, and security that hinder a quick adoption of BSNs. To address the identified issues they propose using body-coupled communication (BCC) for the automatic formation of BSNs and for user identification. They also present a lightweight mechanism that enables a transparent security setup for BSNs used in pervasive healthcare systems.
INTRODUCTION

Wireless Body Sensor Networks (BSNs) are an enabling technology for the paradigm shift towards pervasive health monitoring. Instead of the traditional event-driven model where patients go to their doctor only when they are sick, we envision that a person’s state of health is continuously monitored through the use of smart body-worn medical sensors to detect changes to the worse before a critical condition arises. Thereby emergency cases are prevented and both patients and care givers are empowered to act more proactive in general. However, pervasive health monitoring systems will be widely adopted only if users experience them as easy-to-use and trustworthy, which is a challenging task as we illustrate in this chapter.

Although several wireless technologies are available to allow body-worn sensors to communicate with one another, they all presume that the user has connected all her body sensors to a single network. But since existing wireless standards fail to provide support for setting up a network, this turns out to be a difficult job, asking too much of normal users. We propose a mechanism for making wireless body-worn medical sensors aware of the person they belong to by combining body-coupled with wireless communication. This enables a user to create a wireless BSN by just sticking the sensors to her body.

We exploit Body-Coupled Communication (BCC) to also eliminate the mixing up of medical data from different patients, which is a common source of errors. For this the user wears a personal identifier that broadcasts her unique user ID around her body. Thereby all her body-worn sensors are able to unambiguously annotate their readings with her ID.

Protecting the user’s privacy and ensuring confidentiality of medical data is essential for the acceptance of any pervasive healthcare system. To this end we describe a security system for BSNs that takes the resource constraints of tiny sensors into account and can be rolled out in an easy and unobtrusive way.

The remainder of the chapter is organized as follows. Section 1 introduces the concept of wireless medical BSNs by describing some sample applications and suitable available and upcoming wireless technologies. In Section 2 we present our approach for automatic network formation and user identification based on BCC. A lightweight security system for pervasive BSNs is described in detail in Section 3. In Section 4 we identify some future trends relevant for the deployment of BSNs followed by our conclusions in Section 5.

WIRELESS MEDICAL BODY SENSOR NETWORKS

Concept and Applications

Wireless medical BSNs are an enabling technology for the application domain of unobtrusive health monitoring. This field includes continuous cable-free monitoring of vital signs in hospitals (Philips Medical Systems, 2005), remote monitoring of chronically ill patients (Herzog, 2004; Kraemer, 2006; Lo, 2005), monitoring of patients in mass casualty situations (Malan, 2004), monitoring people in their everyday lives to provide early detection and intervention for various types of disease (Habetha, 2008), computer-assisted physical rehabilitation in ambulatory settings (Jovanov, 2005), and assisted living of elderly at home (Eklund, 2005).

A wireless medical BSN consists of smart wireless sensors measuring for example electrocardiogram (ECG), non-invasive blood pressure and blood oxygen saturation. By means of advanced low-power radios the body-worn sensors can communicate with one another or with nearby devices (e.g. stationary Internet gateways or mobile phones) within a range of typically 5 to 10 meters.
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