Towards RF Communication and Multiple Access Protocols in a Body Sensor Network

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Abstract

A Body Senor Network (BSN) allows the integration of miniaturized, intelligent, low power, invasive, and non-invasive wireless sensor nodes to monitor body function and the surrounding environment. The inclusion of wireless sensor nodes within the body requires many more constraints to be met for safe and reliable operations. In this paper, we first study the possibility of Radio Frequency (RF) communication to an implanted device. Then we provide a simulation study of various multiple access protocols for a non-invasive BSN. For RF communication, we use a Perspex tank that mimics the electrical properties of the body at 400MHz. The results show that the implant reveals best performance at 3cm depth and not close to the surface of the skin. Furthermore, we analyze the performance of a Preamble-Based TDMA (PB-TDMA), S-MAC, and IEEE 802.15.4 protocols for a non-invasive BSN using NS-2. Simulation results show that IEEE 802.15.4, when configured in a beacon-enabled mode, performs better than S-MAC and PB-TDMA. Our results also suggest the design and implementation of a new low-power multiple access protocol for invasive and non-invasive BSN.

Keyword

Body Sensor network, Multiple Access Protocols, Medium Access Protocols, IEEE 802.15.4, S-MAC

1. Introduction

Communication for on body and in body applications is growing for a wide variety of applications. The remote monitoring of body status, and the surrounding environment, are becoming more important for sporting activities, the safety of members of the emergency services, members of the military and health care. The levels of fitness required for the very competitive international sporting events require athletes to be at the very pinnacle of fitness with every muscle used to its utmost. Furthermore, many body functions are traditionally monitored only rarely and separated by a considerable period of time. This can give a very incomplete picture of what is really happening. Consider a patient visiting a doctor for a blood pressure check; he/she may be anxious and thus have elevated pressure resulting in an inaccurate diagnosis. If, however, the patient can be fitted with a simple monitoring system that requires no intervention, then a picture can be built up of how the pressure changes through the day when he/she goes about their normal business. This will give a better picture of what is happening and remove inaccurate results caused by going to visit the doctor. To achieve these requirements, monitoring of movement and body function are essential. This monitoring requires the sensors and wireless system to be very lightweight and to be integrated un-obtrusively into the clothing.

A Body Sensor Network (BSN) allows the integration of intelligent, miniaturized, low power, invasive and non-invasive sensors to monitor body function and the surrounding environment. Each intelligent node has enough capability to process and forward information to a base station for diagnosis and prescription. A BSN provides long term health monitoring of patients under natural physiological states without constraining their normal activities. It can be used to develop a smart and affordable health care system and can be a part of diagnostic procedure, maintenance of chronic condition, supervised recovery