Midterm Project Abstract

This survey will focus on MAC protocols for Body sensor networks. I have selected three papers for this survey which are as follow:

1) Energy Efficient Medium Access Protocol for Wireless Medical Body Area Sensor Networks
2) Energy-Efficient Low Duty Cycle MAC Protocol for Wireless Body Area Networks
3) Heartbeat-Driven Medium-Access Control for Body Sensor Networks

These papers are advanced MAC layer protocols, specifically designed for Body Sensor Networks to minimize the power usage in the network without compromising on the quality.

We first talk about wireless sensor networks specifically designed for low data rate applications. Which demonstrates a novel energy-efficient MAC Protocol designed specifically for wireless body area sensor networks (WBASN) focused towards pervasive healthcare applications. Wireless body area networks consist of wireless sensor nodes attached to the human body to monitor vital signs such as body temperature, activity or heart-rate. The network adopts a master-slave architecture, where the body-worn slave node periodically sends sensor readings to a central master node. Unlike traditional peer-to-peer wireless sensor networks, the nodes in this biomedical WBASN are not deployed in an ad hoc fashion. Joining a network is centrally managed and all communications are single-hop. To reduce energy consumption, all the sensor nodes are in standby or sleep mode until the centrally assigned time slot. Once a node has joined a network, there is no possibility of collision within a cluster as all communication is initiated by the central node and is addressed uniquely to a slave node. To avoid collisions with nearby transmitters, a clear channel assessment algorithm based on standard listen-before-transmit (LBT) is used. To handle time slot overlaps, the novel concept of a wakeup fallback time is introduced. Using single-hop communication and centrally controlled sleep/wakeup times leads to significant energy reductions for this application compared to more “flexible” network MAC protocols such as 802.11 or Zigbee. As duty cycle is reduced, the overall power consumption approaches the standby power. The protocol is implemented in hardware as part of the Sensium™ system-on-chip WBASN ASIC, in a 0.13- m CMOS process.er
However, this protocol is not efficient in high data rate application and also does not provide real time updates of any emergency or critical situation being observed.

To solve these problems we will discuss an energy-efficient medium access control protocol suitable for communication in a wireless body area network for remote monitoring of physiological signals such as EEG and ECG. The protocol takes advantage of the static nature of the body area network to implement the effective time-division multiple access (TDMA) strategy with very little amount of overhead and almost no idle listening (by static, we refer to the fixed
topology of the network investigated). The main goal is to develop energy-efficient and reliable communication protocol to support streaming of large amount of data. TDMA synchronization problems are discussed and solutions are presented. Equations for duty cycle calculation are also derived for power consumption and battery life predictions. The power consumption

model was also validated through measurements. Our results show that the protocol is energy efficient for streaming communication as well as sending short bursts of data, and thus can be used for different types of physiological signals with different sample rates. The protocol is implemented on the analog devices ADF7020 RF transceivers.

Given the amazing work in these protocols, we can still find some way to reduce synchronization energy loss that happens in wireless sensor networks by using naturally occurring biological rhythm signals that a body sensor networks is already tracing.

This protocol is an unconventional method for synchronization in sensor networks which Is called a novel time division multiple access based MAC protocol designed for body sensor networks (BSNs). H-medium-access control (MAC) aims to improve BSNs energy efficiency by exploiting heartbeat rhythm information, instead of using periodic synchronization beacons, to perform time synchronization. Heartbeat rhythm is inherent in every human body and observable in various bio signals. Biosensors in a BSN can extract the heartbeat rhythm from their own sensory data by detecting waveform peaks. All rhythms represented by peak sequences are naturally synchronized since they are driven by the same source, i.e., the heartbeat. Following the rhythm, biosensors can achieve time synchronization without having to turn on their radio to receive periodic timing information from a central controller, so that energy cost for time synchronization can be completely eliminated and the lifetime of the network can be prolonged. An active synchronization recovery scheme is also developed, including two resynchronization approaches. The algorithms are simulated using the discrete event simulator OMNet++ with real-world data from the Massachusetts Institute of Technology–Boston's Beth Israel Hospital multiparameter database Multiparameter Intelligent Monitoring for Intensive Care. The results show that H-MAC can prolong the network life dramatically.

The aim of the survey is to identify new applications where a combination of these technologies can be used and identify the tradeoffs and advantages associated with each style of MAC protocol.