RELIABLE COMMUNICATION IN BODY AREA NETWORKS

A Wireless Body Area network (WBAN) consists of multiple tiny low-power intelligent wearable or implanted wireless sensor nodes that normally communicate to a remote node called a “hub”. The sensor nodes can collect various important physiological data for diagnosis or fast emergency response and deliver various personalized therapeutic treatment related applications and services and receive command and control signals from the hub. WBAN is an emerging technology that has gained applications from health-care to entertainment, games, and sport science. It is expected to enhance the patient’s health-care experience by providing independent living solutions for people that need constant health care. Furthermore, WBAN can reduce the demand on the health-care infrastructure and medical staff in the hospitals. People with chronic diseases that require constant monitoring, elderly people with Alzheimer disease, etc. are among the target groups in the medical applications.

Besides all these motivations, there are several challenges that bring about a theoretical gap between the capabilities of the current wireless networks and those required by a WBAN. The small form-factor of the sensor nodes as well as their limited energy resources (mostly from a battery) poses several design constraints in terms of energy efficiency and computational complexity. Additionally, the WBAN channel represents very dynamic characteristics caused by movements, the individual’s posture, and the unpredictable randomness associated with different ages, genders, body shapes and tissues among different individuals.

Altogether, these facts suggest that the transmitter at the sensor node should exhibit optimal energy efficiency with minimum compu-

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tational complexity in order to meet the expected performance requirements. We are therefore, interested in making them as simple and efficient as possible while the reliability is not compromised. In addition, since the nature of the transmitted data in such systems can be vitally important, we need to improve their reliability in harsh channel conditions.

Essentially, there is a unique combination of four major requirements in a realistic BAN:

Our main objectives can be enumerated as follows

- Minimum computational complexity and maximum energy efficiency at the transmitter nodes
- Protection against channel errors without imposing complexity at the sensor nodes
- Improving the robustness of the system at poor channel conditions

We mainly leverage signal processing and coding techniques to achieve the design objectives. Furthermore, we try to optimize the transmission protocol to improve the efficiency of the system as well. In general, usually the sensor nodes transmit their measured data to an aggregator node that has much higher energy and computational resources. The hub node can tolerate a higher level of computational load compared to the sensor nodes. Therefore, we have an asymmetric characteristic in terms of the feasible transmitter and receiver complexities. Based on this fact, we are interested in designing techniques that demand minimum energy and computational cost at the sensor nodes but instead are more demanding at the receiver side.

To summarize, the main research contributions in this projects are in the following domains:

- Partial Packet Recovery (PPR) designed for WBANs
- Low Complexity Coding techniques
- Generalized Non-uniform Sampling for Efficient Transmission

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