Radiation Aware Efficient Sensor Deployment and Optimal Routing in Dynamic Three-Dimensional WBAN Topology

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ABSTRACT

This work further investigates paradigm of radiation awareness three-dimentionnel models for WBAN network environments. The authors incorporate the effect of dynamic topology as well as the time domain and environment aspects. Even, if the impact of radiation to human health remains largely unexplored and controversial. They ask two fundamental issues, (a) deployment and (b) information routing taking into account radiation awarness. The authors first propose a multi objectives flow model which allows describing a new optimal deployment model for WBAN sensor devices with dynamic topology and the relevant possible trade-offs between coverage, connectivity, network life time while maintaining at low levels the radiation cumulated by wireless transmissions. They propose oblivious deployment heuristics that are radiation aware. The authors then combine them with dynamic spectrum management is proposed based multi-commodity flow model which allows to prevent sensor node saturation and take best action against reliability and the path loss, by imposing an equilibrium use of sensors during the routing process in order to "spread" radiation in a spatio-temporal way. Experimental results show that the proposed models and algorithms balances the energy consumption of nodes effectively, maximize the network lifetime . It will meet the enhanced WBANs requirements, including better delivery ratio, less reliable routing overhead. Their proposed radiation aware deployment and routing heuristics succeed to keep radiation levels low.

Keywords: *Deployment, Dynamic Topology, Radiation, Reliability, Routing, Sensors, WBAN*

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1. INTRODUCTION

WBAN applications cover patients' telemonitoring health state, tracking and monitoring patients' movements, drug administration and diagnostic applications (Penders. J., 2011). In the field of patients health state, WBANs are particularly useful for patients under medical observation. It allows the integration of intelligent, miniaturized, low-power, invasive/non-invasive sensor nodes in/around a human body that are used to monitor body's functions. Each intelligent node has enough capacity to process and forward informations to the sink for diagnosis and prescription. WBANs should be robust against frequent changes in the network topology; The data mostly consists of medical information. Hence, high reliability and low delay is required; The devices used in WBANs have limited energy resources available and consequently the computational power and available memory of such devices will be limited (Ullah. S H. H., 2012; Crosby, 2012). Also, radiation impact of sensors may be high in WBANs where sensors lie close to vital organs and wearable (or even implanted). This poses a number of challenges on the design and analysis of WBANs. Considerable attention had been paid to develop reliable sensor network communication protocols. In summary, new ideas on the fundamental limits for in/on body sensors deployment, routing, radiation management and reliability in such systems are needed. The new mechanism can maintain the features of WBANs such as multihop routing and dynamically environmental changes in a complete autonomous mode. Maximizing lifetime and other constraints as reliability and minimizing radiation are conflicting objectives and thus warrant a trade-off (Nikoletseas. S, 2006). The remainder of this paper is as follows: in section 2, we present works related. Section 3 presents our optimal model and a mathematical formulation using non-convex optimization. We introduce a Min-Max multi-commodity flow description and formulation, based on radiation, reliable model and network energy consumption problem. Finally, examples and experimental comparative studies will be discussed. In section 4, we will introduce respectively, the proposed DDTC Algorithm and a Min-Max multi-commodity flow reliability computation model based on network energy consumption problem. An experimental comparative study is presented.

Then we will discuss and conclude by presenting the future trends of our approach in section 5.

2. RELATED WORK

We ask two fundamental issues, (a) deployment and (b) information routing taking into account radiation awarness.

The impact of radiation attracted the attention of several researchers from different research fields. We mention an interesting book (Allan, 2010) which concentrates on reliability and the effects of radiation. The reliability can be considered either end-to-end or on a per link base. Examples of reliability include the guaranteed delivery of data (i.e. packet delivery ratio), in-order-delivery etc. Moreover, messages should be delivered in reasonable time. The reliability of the network directly affects the quality of patient monitoring and in a worst case scenario it can be fatal when a life threatening event has gone undetected . The propagation of the waves takes place in or on a (very) lossy medium, the human body. As a result, the waves are attenuated considerably before they reach the receiver. The devices are located on the human body that can be in motion. WBAN should therefore be robust against frequent changes in the network topology. The radiation aspect still largely unexplored in the context of WBANs. We point out that known adaptive power control methods in cognitive networks (such as using radio optimizations and smart antennas), do not focus on the aspect of radiation impact.

We stress that adaptive power control methods in cognitive networks, do not focus on the aspect of the impact of radiation. Another problem which is different to radiation prob-

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