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Network Management for Cost Minimization and Energy Efficiency in Wireless Body Area Networks

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ABSTRACT

Recently significant research works reported on communication standards of wireless body area networks (WBANs) due to emergence of WBAN in real time applications. There two primary challenges in opportunistic WBANs such as network management cost reduction and energy consumption reduction in order deliver the cost-effective and reliable services to critical patients in healthcare application. There are number solutions reported to address this challenges in recent past, however failed to cover all the aspects of WBANs communication. In this, paper we proposed novel opportunistic communication protocol for WBANs with aim to solve the research challenges not only the energy efficiency and network management cost reduction but also solves the problem non-reliable nodes data dissemination. First we proposed the novel energy-efficient and distributed network management cost minimization framework for dynamic connectivity and data dissemination in opportunistic WBANs. Then proposed the pricing based approach for reliable node data dissemination. This can be done by reputation-based incentive methods to motivate participants to disseminate reliable data in participatory sensing system, while minimizing incentive cost for maintaining sufficient number of reliable participants.

Keywords: AP , BAN , LPU, MEMS, WBAN

1. Introduction

Due to the advancements in MEMS and wireless communication technologies, WBAN has undergone a technical boom in the last decade. The schematic overview of differences between Wireless Sensor Networks and Wireless Body Area Networks is given by [1]. There are significant points to be noted in the Wireless body area network. As opposed to the wireless sensor network, the WBAN monitoring environment is restricted to the human body, heterogeneous data rate, the requirement of biocompatible sensor devices and more variable network topology due to body movement. A WBAN provides real-time electronic healthcare services to medically emergent patients in a cost effective manner. In a WBAN, several body sensor nodes are implanted on/in the human body to sense the physiological signals of

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patients. After sensing the physiological signals, the sensor nodes send the sensed data to the Local processing Unit (LPU). Subsequently, the LPU transmits the aggregated data to the local access points (APs), which, in turn, send them to the medical servers [3], [4]. The body sensor nodes transmit the medical data to LPUs at wide range of data rates from 10 Kb/s to 10 Mb/s [5]. Also, the energy consumption rates of sensor nodes are restricted to certain limits, as the battery power of these nodes is limited. To minimize energy consumption, the sensor nodes use a one-hop star topology to send their medical data [6]. However, mobility, body postures, and environmental obstacles increase the dynamism in WBANs, which frequently changes the network topology, which, in turn, decreases the network QoS. Additionally, the link-quality between nodes in WBANs varies as a function of time due to various body movements, which also affects the inter-node connectivity [7].Due to body movements and mobility of WBANs [6], the link qualities of intra-BAN and inter-BAN communication units degrade significantly, which increases the packet loss rate and decreases the life-time of the body sensor nodes. Further, the above also disrupts data dissemination. Therefore the QoS management cost in the network is increases in order to maintain fair QoS among WBANs. we need a network management cost minimization framework to provide reliable and cost effective service to WBANs. We introduced energy efficient and QoS efficient communication protocol for WBAN based on energy management cost minimization and QoS management cost minimization with reliable data dissemination.

1.1limitations of Existing Methods

- The QoS of WBANs is decreases if the mobility of WBAN in increasing.
- The existing solutions for WBAN communications are not efficiently handling the mobility variations.
- The state-of-art methods suffered from the sever dissemination delay as well as energy consumption.
- The participants' reluctance would diminish their enthusiasm if there is no incentive mechanism.

2. Problem Statement

In real time cases, there two key challenges for WBAN to solve such as energy efficiency as well as QoS efficiency. The body sensor networks are having limited processing power as well as mobility, body postures, and environmental obstacles increase the dynamism in WBANs, which frequently changes the network topology, which, in turn, decreases the network QoS. Therefore, designing energy efficient and QoS efficient communication protocol for WBAN is main research problem for this work

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2.1 Methodology

To solve current problems, we proposed technique that not only the energy efficiency and network management cost reduction but also solves the problem non-reliable nodes data dissemination. First we proposed the novel energy-efficient and distributed network management cost minimization framework for dynamic connectivity and data dissemination in opportunistic WBANs. Then proposed the pricing based approach for reliable node data dissemination. This can be done by reputation-based incentive methods to motivate participants to disseminate reliable data in participatory sensing system, while minimizing incentive cost for maintaining sufficient number of reliable participants.

2.2objectives

- The aim of this work is to present novel opportunistic data communication algorithms to achieve the efficiency, QoS and reliability for WBANs.
- To study the different opportunistic based routing methods for WBANs.
- To study the energy efficient methods for WBANs.
- To present novel algorithms for WBANs to address the recent challenges of state-of-art methods.

To simulate and evaluate the proposed algorithm against the state-of-art

3. Review of Literature:

Benoit Latre, Bart Braem, Ingrid Moerman, Chris Blondia & Piet Demeester 2011 et al. proposed The schematic overview of differences between Wireless Sensor Networks and Wireless Body Area Networks is given by [1].

Samanta et al. [8], [9] proposed a link-quality-aware resource allocation cum load balancing scheme for node in WBANs. In this method, the authors has used two sub problems — link-quality measurement and dynamic resource allocation in WBANs. Though these works deal with the mobility of WBANs, they do not consider the dynamics of network management cost in the presence of body/limb movements in WBANs, due to which the total network cost increases and the QoS of WBANs increases.

Elias at al. [10] proposed an energy-aware optimal design of energy efficient and cost-effective WBANs. Though this approach proposed a cost-effective model, the authors did not consider the effects of dynamic connectivity and opportunistic data dissemination in WBANs. This increases the delay and packet drop of the network.

Zhao et al. [11] proposed a network cost minimization scheme for data dissemination in Wireless Sensor Networks (WSNs). First, this model does not consider the criticality index of WBANs in order to quantify the

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medical conditions of WBAN-equipped patients, which is one of the distinct features of WBAN-based communications.

Energy-efficient and reliable communications are important requirement of WBANs, as they carry sensitive medical data. Due to shadowing and fading effects in the networks, the energy consumption rate of sensor nodes increases, and also the reliability in data transmission decreases, periodically. To increase the energy efficiency and reliability in data transmission recently number of methods reported.

Yousaf et al. [12] proposed a new three-stage cooperative relaying scheme for WBANs. As body sensor nodes produce medical data at a variable rate, their corresponding traffic pattern is uncertain in nature. Therefore, in the presence of poor link-quality, the packets drop rate of the network and the energy consumption of body sensor node increase.

4. Proposed System

To solve the current research problem for dynamic WBAN communications, we proposed novel opportunistic communication protocol for WBANs with aim to solve the research challenges not only the energy efficiency and network management cost reduction but also solves the problem non-reliable nodes data dissemination. First we proposed the novel energy-efficient and distributed network management cost minimization framework for dynamic connectivity and data dissemination in opportunistic WBANs. Then proposed the pricing based approach for reliable node data dissemination.

We introduced a pricing based approach to optimize the network management cost for opportunistic WBANs. Concurrently, the behaviours of WBANs are taken into the consideration (i.e., critical and normal condition) to provide reliable services. We proposed algorithms: (1) energy efficient prioritized opportunistic communications algorithm, (2) optimal network cost reduction algorithm. As the dynamic topological disconnections as well as variations in link qualities increases the energy consumption rate of opportunistic WBANs, we design the energy-efficient prioritized opportunistic communication to optimize the energy consumption rate of WBANs. to optimize the reliable data communication approach, we design the pricing technique in this project. The pricing method rewards the nodes that relay others' packets and charges those that send packets. The trust system evaluates the nodes' competence and reliability in relaying packets in terms of multi-dimensional trust values. The trust values are attached to the nodes' public-key certificates to be used in making routing decisions. We develop routing technique to transmit the data via those highly-trusted nodes having sufficient energy to minimize the probability of breaking the route. This proposed technique can maintain route stability and report correct battery energy capability. This is because any loss of trust will result in loss of future earnings. Moreover, for the efficient implementation of the trust system, the trust values are computed by processing the payment receipts. Figure 1 shows the architecture for the proposed pricing based data dissemination in WBANs.

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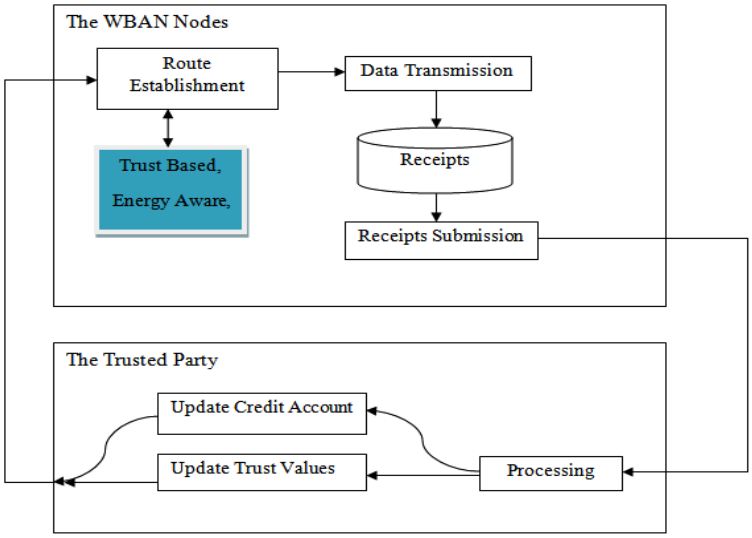

Figure 1: Pricing based data transmission

4.1 Software Environment

Network Simulator (Ns-2)

NS2 is stand of the Network Simulator Version 2 which is targeted specially for the networks simulations. NS2 is nothing but the discrete event simulator for the researches in the area of networking. NS2 provides the simulation and research supports for the wired networks, wireless networks by using TCP, and UDP, IP, and CBR patterns of the communications. NS2 is made of two parts basically such as NS means network simulator and other one is NAM means network animator. NS is used to simulate all the protocols like commonly used IP protocols over the wireless as well as wired networks. On the other hand, the network animator tool is used to visualize the simulation of the networks in the form of actual communication patterns. NAM supports the wired network simulation fully as compared to wireless simulation which is possible only partially with the NAM. NS2 is the recent version 2 of the network simulator which was developed and published by the one the university in the Berkeley city called as University of California. But after that, VINT project as well. Initially network simulator was developed only for the wired networks; recently Carnegie Mellon University in 1999, extended the working and simulation of the NS2 for the wireless ad hoc networks means MANET as well.

5. Result

Following graphs shows results of existing system and proposed system. NNCDM i.e. our proposed system model has better results as compared to the other available protocols

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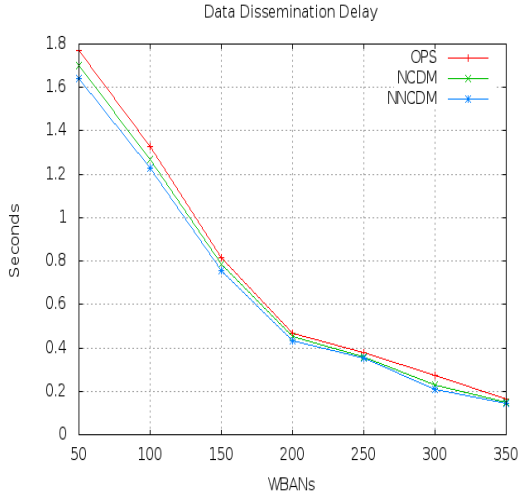

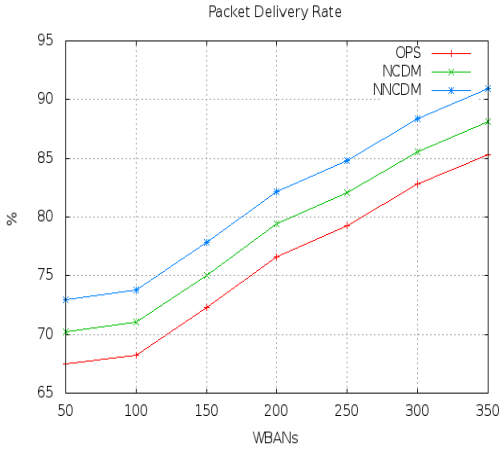

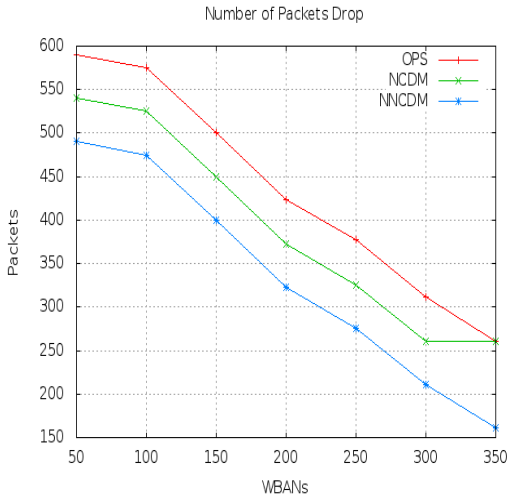

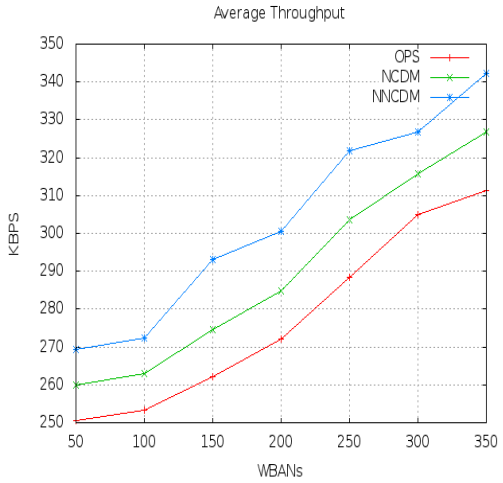

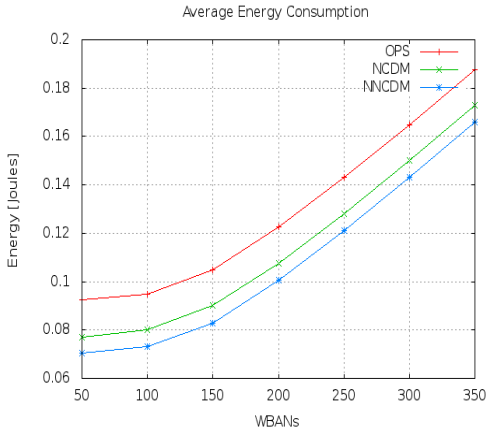

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Protocol / Parameters	OPS	NCDM	NNCDM
Data Dissemination Delay	High	Average	Low
Number of packet drops	High	Average	Low
Average Energy Consumption	High	Average	low
Packet Delivery Ratio	Low	Average	High
Average throughput	low	Average	High

Table1: Simulation Results

6. Conclusion

In this paper, we proposed the network management cost reduction approach for the opportunistic WBANs in order to manage the increased cost of network management. We first designed the joint distributed network management cost reduction algorithm and energy-efficient algorithm for the dynamic data dissemination process in the opportunistic WBANs. Then we introduced pricing based data transmission for the reliable and stable route selection. For future work, it will be interesting to investigate the variations in other important parameters of WBAN such as mobility speed, packet rate etc through the experimental studies.

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