Ensuring QoS in Wireless Body Area Network: A Review

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Abstract

Objectives: Wireless Body Area Networks (WBANs) have gained immense popularity among researchers and this field has also touched the health sector. In this paper we have analyzed the various methods that are used to ensure the QoS in body nodes in WBANs. Methods/Statistical Analysis: The better functioning nodes with longevity of the battery nodes help to exchange the messages between the nodes uninterruptedly. Various works are presented each for improving the quality of one part or another of the network. The importance of the various methods and how these have benefitted in the better management of the sensor nodes has also been presented. The review of the researches that are undergoing in this field has been given. Findings: The body nodes work more efficiently if the interrupted energy supply is provided to them. Energy can be collected from the body movements also and can prove to be more beneficially limiting the health constraints of removing batteries again and again. Some scheduling algorithms can reduce the interference between the nodes and the routing protocols can manage the data traffic among the WBAN. The power optimizing techniques reduce the power consumption and the data loss. So many techniques provide the much needed quality of service in WBAN. Novelty/Improvement: The paper brings out various techniques which assist in better WBAN thus reinforces the use of wireless sensors in the health domain with better quality.

Keywords: Body Nodes, Energy Harvesting, Medium Access Control (MAC), Quality of Service (QoS), Wireless Body Area Network (WBAN)

1. Introduction

The Wireless Body Area Network (WBAN) is creating a new milestone in managing the human health. With increasing ailing population the need to monitor the health of the patients has increased both inside the hospitals and outside also. This increasing demand has been met by breakthrough in the wireless technology that is there are sensor nodes and mobile electronic devices connected in the network forming WBANs. This functions by interacting with the medical aids and sensors which are sometimes in grained inside and sometimes outside in the pockets or wallets. These days the applications of WBANs are growing manifolds and many new devices have also been invented. The smart shirts, implantable sensors, ECG regulators are some of the things that are being used in the health monitoring in WBANs. Now, health being a sensitive field, it also involves lots of concerns regarding health and privacy also. The appropriate data and signals must be picked up by the sensors; the data must be latest and authenticated also. So, the QoS is most pressing concern in implementing the WBANs in the health regulation. The space for the nodes in human body is also another concern because each of the nodes has its unique function and the nodes must not create obstruction for functioning of patient so the BNs (Body Nodes) should be quite small and weight should also be very less. WBANs are closely related to WSNs both containing the sensor nodes and serving the different purposes. So along with health care the wireless sensors also serve purpose in the environment monitoring, military surveillance, making digital homes, tracing vehicles.
WBAN at present is at initial stage, but owing to its widespread usage and as it promises to change the scenario, so the extensive research in the field into next new levels. Various standards such as IEEE 802.15.6 in WBAN meet the increasing and changing demands of WBANs.4

2. Quality of Service in WBAN

WBANs have diverse function, so QoS ensure that the technology is tapped at its fullest and the challenges can also be overcome. The limited resources and the power needed to charge the sensors are some of the WBANs are facing at the present moment. The various QoS metrics for WBAN technology majorly focus on how to decrease the overall utilization of energy and maximize the life of the network along with the network throughput. It also aims to reduce the end to end delay and ensure more reliable communication with avoiding the collisions and congestion.3

3. Various Works for QoS Provisioning

Ernesto Ibarra introduced PEH-QoS scheme which aims at proper usage of the energy that is collected from the human movements and improve the QoS. By utilizing the energy that is produced by the movements of the body, the problem of charging the battery of nodes through external modes can be reduced. They divided the system into three modules and proper interaction of these aims to achieve QoS. The PEH- QoS that they employed on ECG which they had simulated showed that the detection efficiency got improved along with enhancing storage capability.6 The same author also worked on harvesting of the energy from the human environment, the scheme that they introduced was implemented on various human activities such as relaxing, walking, cycling and also running. The throughput of the system also got increased.6,7 The authors worked on QoS providing framework which managed the WBANs traffic. They made use of their proposed system and its integration with the IEEE 802.15.4 MAC layer protocol.8 Another author developed a new and interesting model for adding facilities of QoS in Body Sensors Networks. Their proposed model relied on traffic model same as ON/OFF process and showed self similar behavior and was able to handle long range traffic patterns. They used G/M/I queuing system and with help of Low Latency queuing they were able to work on QoS characters like delaying the packet loss.2 One author presented two techniques which maintain QoS even when sensors are dying out. Their first technique used Gur Game with QoS feedback is providing to each sensor and in the second one this feedback goes to each individual sensor. The author’s work presented QoS control plan which extended the lifetime of environment in harsh environment by properly using the low-energy Random access protocols.11 In one work authors proposed application of 802.11 which is a wireless standard to support QoS within the areas of e-medicine and tele health. Their presented architectures and novel scenarios helped in guarantee of QoS even in the emergency scenarios.11 Clique Based WBAN scheduling for Mobile Wireless Body Area Networks was presented by another authors. They grouped the sensors of one WBAN or more into the groups so that the interference can be avoided. In the line of time slots they scheduled the groups by using a coloring based scheduling. Throughput got increased thus provisioning another parameter of QoS.12 The author’s also proposed QoI (Quality of Information) aware energy management scheme to decide the state of participation of each and every sensor node. Making the use of GurGame, they managed to reduce QoI outage and also bulk of energy reserve got saved and hence addressing another parameter of QoS implementation.13 Researchers proposed a system level energy consumption model which was associated with transmission distance and with a proper analysis of threshold distance they were able to save energy.14 A work proposed Body QoS which is running QoS system, had adopted a symmetric architecture by which processing was being done on resource rich aggregator and it decreased the load on the sensor nodes. Also virtual Mac was developed making it radio-agnostic by which wireless resources got scheduled without knowing the below MAC protocols achieving a better system.15 They proposed in-to-out (I20) human body Path Loss (PL) model at 2.4 Ghz which was based on 3D heterogeneous human body modes. The QoS metric were achieved and networks lifetime got maximized, increasing throughput and decreasing delay.16 An author analyzed a sensor node with a fixed service rate and another which had a variable rate for power usage and data loss in smaller buffer under varied conditions. Coordinated Power Management was used and due to better coordination between processing and communication, energy got optimized and data loss got reduced.17 A work proposed data centric multi
objective QoS-Aware Routing protocol named DM QoS which aids system to get QoS services of each traffic category differentiated according data types. Another work proposed a Quality of Service (QoS) routing protocol which depends on traffic diversity. This method is based on modular approach where according to QoS metrics data traffic gets classified into various categories and the protocol attempts for each packet to satisfy QoS metrics and can operates with any MAC protocol. The author proposed an Express Dual Channel (EDC) based QoS provisioning mechanism which would aid in providing QoS over the wireless channel between Body Sensor Network (BSN) Gateway and various Access points. In this work authors proposed Random Contention Based Resource Allocation (RACOON) which is a Medium Access Control (MAC) protocol which supports QoS for the multiuser mobile WBAN and this considers both inter-WBAN interference and priorities and provides better latency and energy control. The author proposed a model which showcases QoS requirements in four major dimensions namely traffic pattern, channel reliability, delay and throughput bound. A work presented TM QoS which is intra-body QoS routing protocol which intends to meet QoS demands of varying application along with maintaining temperature of nodes. The authors proposed a MC-MAC that is Mobile Cluster MAC which supports clustering in WSNS, also they proposed mechanisms for optimization to reduce the power usage. The author proposed novel low-delay traffic adaptive medium access control (LDIA-MAC) protocol, in which time slots are allocated according to load of traffic and accommodates more devices. The author proposes QoS support mechanism for wireless remote health care system which aids in scheduling along with management of queue. The authors Long Hu et al. proposed multiple level based QoS design in WBAN MAC layer in three levels and addresses issue of various priorities of many users.

4. Conclusion and Future Work

Wireless Body Area Network is providing a never perceived before service in computerizing the health care application. It being a relatively new field, researchers are increasingly adding their bit into this and greatly contributing by working on the various parts of WBAN including QoS. In this paper we covered maximum techniques and the protocols which have been employed by various researchers. These are the techniques which ensure in achieving high QoS in one part or the of the body area network, thus allowing seamless communication in aiding the monitoring of the patient health. The content which is given in paper depicts the techniques and protocols used in various works to get QoS. In future we want to device methods which can add to work in improving QoS and with extensive simulations show the achieved parameters.

5. References


