

Packet Size Optimization Techniques and Challenges for Wireless Body Area Networks

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Abstract – As of late, Wireless Body Area Network (WBAN) has attracted huge enthusiasm to numerous analysts because of its potential in medicinal services and therapeutic fields. In this paper, we propose the vitality productivity model of Time Diversity correspondence in Rician and Rayleigh blurring channels stressing the ideal packet size. The ideal packet size to amplify vitality effectiveness is explored for on-body and in-body channels. Four regulation systems are considered including the as of late proposed 16-ary Quadrature Amplitude Position Modulation (QAPM). What's more, the shut structure articulation of the vitality effectiveness model in multipath blurring is inferred. Here, three assessment measurements including the vitality productivity, the standardized throughput and the normal start to finish delay are embraced and contrasted with the current 1-bounce and Cooperative correspondences just as our recently proposed 2-jump correspondence. The outcomes show that our proposed Time Diversity correspondence plot outflanks the current ones in profound blurring channel aside from the normal start to finish delay.

Keywords: Energy Proficiency; Network Reliability; Cross-Layer Design; Packet Size Optimization; Wireless Body Area Network

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INTRODUCTION

Power use is the most irksome resource prerequisite to be satisfied for BANs among the challenges referenced before. Thusly, various energy-aware strategies are planned for offering power to save and deal with the power on both connection layer and network layer. In spite of the way that vitality is eaten up by methods for the sensors while distinguishing, correspondence, and transmitting the data while in transit to the sink, correspondence control use is the prevalent term in BANs.

Most recent examinations in the territory show that heap of measures straightforwardly influences the execution of correspondence between sensor hubs. It is prominent that because of serious network issue longer packets watch higher information misfortune, though packets with shorter size premise more noteworthy information overhead. To control the trade-off between network trustworthiness and imperativeness capability, various strategies are foreseen to choose the perfect packet measure in BANs. Figure 1 displays an average link-layer group orchestrate in sensor networks.

Packet group has three essential parts (for example trailer, header and payload). The header contains data identified with current segment number; includes

number of parts and source alongside goal hubs. Trailer field incorporates equality bits to control the mistake. Payload fuses information bits. Length of Header, Trailer, and Payload are spoken to as L_H , L_T , and L_{PL} separately (Figure 1).

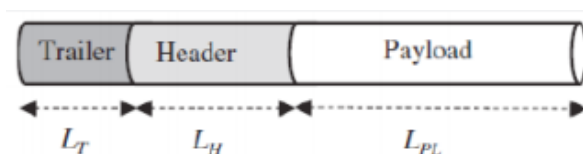


Figure 1.1: Link-layer packet arrangement in BANs.

Packet size can be improved consenting to a few networking criteria's. A few estimations for instance, yield capability and the imperativeness viability are used for execution criteria for enhancement of packet size. For instance, vitality efficiency is used as an improvement metric to choose the settled perfect packet length for growing the vitality capability. The key objective of the exploration is to give a prevalent understanding of packet size enhancement strategies used in WBAN to display unaddressed issues and troubles in this examination territory.

Wireless Body Area Network (WBAN) is one of the wireless networking advances having a ton of uses in human services, medicinal field, sports, military and stimulations. It comprises of wireless detecting hubs that are put on, in or around the human body. Ordinarily, WBAN hubs are arranged into three gatherings: (i) Sensing hubs that include wearable and embedded hubs relying upon their area on the human body.

The previous are put on the human body and primarily used to screen an individual's wellbeing conditions while the last are situated inside the human body, and predominantly used to gather picture data inside the human body. (ii) Coordinator hub (CN) which is answerable for sending the control message to, and gathering data from the detecting hubs. (iii) Access point or checking station. When all is said in done, the correspondence sorts of WBANs can be arranged into on-body and in-body channels. The on-body and in-body channels are the correspondences among wearable and facilitator hubs, and embedded and organizer hubs, individually.

Because of the potential applications in WBANs, IEEE has institutionalized IEEE 802.15.6 for WBANs determining physical and MAC layers. For the most part, vitality proficiency is one of the difficult issues in WBANs, since WBAN hubs are required to work ceaselessly for an extensive stretch of time despite the fact that they are little size, light weight and vitality imperative. In addition, supplanting and energizing their batteries may not be viable when they are in activity. Like Wireless Body Networks (WBANs), multipath blurring can't be disregarded in WBANs also. In and multipath blurring in WBANs is assessed, and it is demonstrated that multipath blurring can be displayed intently by utilizing Rician circulation in the on-body channel.

FEATURES OF WBAN

The main features of WBAN includes the following,

- Node mobility
- Power consumption constraints for node
- Communication failures
- Heterogeneity of nodes
- Ability to endure hard environmental conditions
- Scalability to large scale of deployment
- Cross-layer design
- Ease of use

ISSUES IN WBAN

Lifetime is a significant element of any application and it is for the most part influenced by the vitality use of the current hubs in the network. The power required for information correspondence takes a significant part in vitality utilization. Thus, the activities like information observing, signal preparing unit and equipment unit working in backup mode spend a standard power. The current prerequisites among the different layers in the convention can be considered to reduce the vitality utilization. In certain events, the large scale activation process needs extra power. Steering and channel 12 access convention yields gain from data exchange with the physical layer. This procedure has been finished at this layer with low radio obligation cycles just as utilizing dynamic tweak scaling plan. In this procedure, the array size is changed in accordance with decrease vitality utilization.

WIRELESS BODY AREA NETWORK

Overview

A WBAN is the arrangement of a gathering of vitality proficient, smaller than usual, obtrusive/non-intrusive light weighted wireless sensors that screens human bodies' wellbeing condition and encompassing environment's. Therapeutic consideration framework is one of the most significant application situations for WBANs as portrayed in IEEE 802.15.6 standard [14]. There are 3 subcategories for the WBANs in restorative applications: wearable WBAN, embed WBAN and remote control of therapeutic gadgets [1]. A wearable WBAN is fit for checking rest issue, asthma, evaluating warrior weakness and fight preparation, supporting game preparing to stay away from wounds. For embed WBANs, the sensors are either embedded beneath the surface skin or live in the circulatory system. Capacities, for example, diabetes control, cardiovascular sicknesses observing and malignant growth recognition can be satisfied by embed WBANs. The remote control of medicinal gadgets takes into account Ambient Assisted Living (AAL), in which each WBAN trade data with a back-end restorative network. AAL takes into account programmed restorative consideration for the patients through the WBANs, liberating patients from concentrated individual consideration.

LITERATURE REVIEW

Works On WBANS without Duty Cycle Mechanism Using Simulation Approach

Lee et al. [2013] had seen that if the base estimation of Backo Exponent (BE) is set to 3 in the CSMA-CA component of IEEE 802.15.4, it prompts crashes and they builds holding up time. For the situations when a sensor hub has ceaseless parcels to transmit, they proposed a deferred backoff calculation (DBA) in which sensor hub chooses an arbitrary backoff time

without anyone else's input, rather than being allocated by the facilitator.

Brienza et al. [2014] had proposed a learning-based calculation LEAP, with the target of determining the ideal CSMA/CA parameter for IEEE 802.15.4, that satisfies the dependability imperatives of the application with the base vitality utilization. The calculation gauges the dependability experienced by every sensor hub locally and dependent on the unwavering quality level it sets CSMA/CA parameter esteems. They dissected the calculation through reenactment in both stationary and dynamic situations and dependent on the outcomes they have demonstrated that LEAP beats all past comparative calculations.

Rao et al. [2014] proposed another back o calculation named Adaptive Back-o Exponent Algorithm (ABE). The calculation works dependent on three essential thoughts firstly to give a higher scope of backo types to the gadgets, also to consider least backo example (minMacBE) esteem as a variable rather than a consistent and thirdly to relegate the estimation of least backo type to a hub dependent on its current traffic age rate.

Dahham et al. [2015] had recommended that the hubs would hang tight for an arbitrary number of backo periods utilizing its very own proposed backo system named as Temporary Backo (TB) and Next Temporary Backo (NTB) rather than picking backo type arbitrarily as defined in standard. The presentation of proposed plot is assessed through reenactment and it was inferred that utilization of the proposed plan significantly improves the exhibition of IEEE 802.15.4 system, as far as throughput, parcel conveyance proportion, control utilization and normal postponement.

Ha et al. [2014] had proposed two plans for opened CSMA/CA of IEEE 802.15.4 so as to upgrade its exhibition as far as throughput and vitality efficiency. They balanced the backo type (BE) on finding the channel occupied for two successive openings in clear channel appraisal (CCA) and parcel transmission rate. Wang et al. [74] had proposed an upgraded impact evasion MAC convention dependent on opened IEEE 802.15.4.

Valero et al. [2015] had proposed a component to broaden the lifetime of signal empowered IEEE 802.15.4 remote sensor systems which they named as a gradually deployable and vitality efficient 802.15.4 MAC convention (DEEP). The proposed component works by adjusting the superframe ensured availability (GTS) conveyance instrument of reference point empowered IEEE 802.15.4. They study the presentation of the proposed instrument through reproduction and genuine sensors and found that it diminishes vitality utilization of the system by almost half when seven gadgets are dispensed ensured schedule openings.

Khanafer et al. [2015] had proposed a plan for standard IEEE 802.15.4 that makes every hub to rest for a given timeframe soon after finishing a successful bundle transmission before the appearance of the following parcel for transmission. At long last through a recreation based examination they exhibited that the proposed instrument builds the lifetime of the system, accomplishes more significant levels of channel usage and unwavering quality while safeguarding decency among the hubs in the system.

Works on WBANs with Duty Cycle Mechanism using both Analytical and Simulation Approach

Huang et al. [2016] had displayed an extensive examination of IEEE 802.15.4 with obligation cycle system. Their examination centers around the exhibition of system with change in obligation cycle. They proposed an expository model for IEEE 802.15.4 with obligation cycle component. Their model clarifies goodput and all out power utilization conduct with change in BO, SO values at different load. In view of their reenactment and explanatory outcomes, they presumed that the BO thus esteems have genuine effect on the presentation of the system. Be that as it may, their work doesn't give any knowledge into postpone parameters.

Neugebauer et al. [2017] had proposed a calculation called signal request adjustment calculation (BOAA), to pick the reference point request an incentive for IEEE 802.15.4 hubs. The calculation is pertinent for systems working utilizing star topology with the obligation cycle instrument being empowered. The calculation chooses the reference point request esteem watching the present recurrence of information correspondence by sensor hubs. They have indicated that the calculation is pertinent in powerful system conditions; anyway it is expressed that the calculation is valuable for applications with no constant necessities.

Cho et al. [2014] had proposed a versatile vitality sparing component for the IEEE 802.15.4, which allots the length of the dynamic time frame by changing the Beacon Order (BO) esteem so as to spare vitality. The organizer hub allots the estimation of BO relying upon the present bundle appearance rate. Further they created articulations to process the measure of vitality devoured by a hub with the dynamic time frame being balanced powerfully dependent on current bundle appearance rate. At last they proposed that appropriate choice of BO can broaden the lifetime of the system however inertness may increment.

Jung et al. [2015] had proposed a Markov Chain based expository model for opened IEEE 802.15.4 for unsaturated traffic conditions with obligation cycle and retransmission system being empowered. They planned the expository model to lead a presentation

examination of IEEE 802.15.4 with obligation cycle and re-transmission instrument as far as throughput. Inertness isn't considered as an exhibition parameter of the system.

Xiao et al. [2015] had displayed a logical model comprising of three sub-models; an installed discrete-time Markov lining model, a virtual assistance time model and a Markov-based CSMA/CA model for obligation cycle empowered IEEE 802.15.4. They approved the precision of the proposed model by Monte Carlo Simulations and furthermore gave a presentation examination of IEEE 802.15.4 with changing line length. A similar arrangement of creators [82] had proposed a Markov Chain based systematic model for guide empowered IEEE 802.15.4 with obligation cycle component being empowered. The proposed model is a blend of two sub models. One model was intended to speak to the obligation cycle instrument and the second was for the opened CSMA/CA. From the proposed model they inferred articulations for registering throughput and vitality utilization by a hub. The precision of the proposed model was upheld by NS2 reenactment. At long last they introduced an exhibition investigation of IEEE 802.15.4 indicating the effect of obligation cycle, tra c load and introductory backo type on the presentation of the system. Yet, they didn't consider BO thus esteems as any effect parameters. Comparative Markov Chain based model was additionally proposed by Gao et al. [2015]. Their model can register throughput and power devoured by a hub. NS2 based reproduction was utilized to approve their model. They utilized their model to exhibit the effect of obligation cycle instrument on the presentation of the system. Dormancy factor was not considered.

Works on Beacon Enabled and Non Beacon

Zheng et al. [2015] worked, can be considered as one of the most punctual work on IEEE 802.15.4. They were the pioneer of creating patch in NS2 test system covering, IEEE 802.15.4 PHY and MAC. They additionally did number trials on the IEEE 802.15.4 and the most prominent are the presentation correlation somewhere in the range of IEEE802.15.4 and 802.11 and assessment between the unslotted CSMA-CA and opened CSMACA. From the examination they detailed that at low information rate the parcel conveyance proportion accomplished in non-guide empowered IEEE 802.15.4 is very like that of 802.11 and it has the bit of leeway over IEEE 802.11 as far as control overhead and exchange inertness. Because of absence of RTS/CTS, IEEE 802.15.4 is relied upon to sure from concealed terminal issues; anyway they saw that for low information rates up to one bundle for each second, the exhibition corruption is minor. They recommended that the default back period size utilized in IEEE 802.15.4 is excessively short, which drives the system to visit impacts. Additionally when the system works with low signal requests will confront high crash likelihood at the beginnings of super frames.

Wang et al. [2014] had proposed a Markov Chain based scientific models intended for both opened and un-opened CSMA/CA of IEEE 802.15.4. These models were intended to give a device to complete execution investigation of IEEE 802.15.4 as far as immersion throughput. They approved the precision of the proposed models by NS2 reenactment.

Barely any as of late created explanatory models for IEEE 802.15.4 system without obligation cycle component are additionally talked about beneath.

Haghighi et al. [2011] had proposed an explanatory model for the IEEE 802.15.4 opened CSMA/CA medium access control (MAC) convention. The proposed model was planned accepting burst tra c appearance in IEEE 802.15.4 system without any affirmations instrument. The proposed model figure measurements like the normal parcel misfortune or transmission achievement. They found their scientific model better regarding memory and computational multifaceted nature in contrast with past model.

Al-Jemeli et al. [2012] had proposed an investigative model expecting cross layer activity in IEEE 802.15.4 for portable remote sensor systems (MWBANs). The proposed model works for four layers:- 1) application (hub area); 2) arrange (directing); 3) medium access control (MAC); and 4) physical layers. It was intended to improve the vitality utilization and throughput of IEEE 802.15.4 MWBANs.

Di Marco et al. [2016] had proposed explanatory model for IEEE 802.15.4 system to comprehend the connection among MAC and physical layer of IEEE 802.15.4 system. The examination remembers study for channel blurring and sway on arrange execution because of impedance produced by different terminals. Further, the examination likewise incorporates e cts presented by shrouded terminals and diminished transporter detecting capacities.

Argyriou et al. [2015] had centers around the issue of body shadowing an ects in remote body territory arrange (WBAN). Body shadowing diminishes the capacity of WBAN hubs to speak with the door hub. They proposed another design for WBAN at arrange layer which deals with the two correspondence advancements to conquer this issue. Further a scientific model is additionally created which is utilized in the proposed design to enhance vitality and defer e ciency.

Wang et al. [2014] had proposed an investigative model for IEEE 802.15.4 with no guide empowered mode for Internet of Vehicle (IoV) arrange. They allude IoV arrange as a system innovation which give exceptionally practical correspondence channels to connections between vehicles. The proposed model considers coordinate with enormous number of hubs producing unsaturated tra c. It was intended to give rules to vehicles for progressively

modifying its telecom rate to accomplish a higher likelihood of achievement.

MEDIUM ACCESS CONTROL DESIGN IN WIRELESS BODY AREA NETWORKS

Lots of energy efficient MAC protocols have been developed for WBANs to make them live longer. Actually, some of these designs serve as a foundation for the WBAN MAC designs, such as the idea of periodic sleep mechanism. However, some fundamental differences exist between WBANs and WBANs, so that the existing MAC designs for WBANs are not proper for WBANs. The first problem is that the channel condition of WBANs is much less stable than that of WBANs, which means a fixed scheduling will result in bad performance since channel may fluctuate significantly within the scope of one superframe. The second issue is that the volume of bio-sensors are very tiny, especially for the implantable ones. They are much more power constrained than the other sensors and transmit with lower transmission power, which means these bio-sensors are quite vulnerable to the body channel fluctuation. However at the same time, the data transmissions are required to be highly reliable. So the requirement of avoiding the bad link status and take advantage of the good 15 channels for WBAN is very urgent. Thus we conclude that opportunistic scheduling can be promising at promoting the performance of WBANs. However, most of the existing designs on opportunistic scheduling are for cellular network, which differs significantly from the WBANs. One major difference is that cellular network is much less power constrained compared with WBANs, so that channel probing can be extensively applied, which means the channel status is always available. The objective are different too. The cellular networks generally focus on throughput and fairness, while WBANs focus on reliability and energy consumption. So special opportunistic scheduling algorithms need to be developed for WBANs so that they are able to estimate channel status without probing it and make wise scheduling accordingly.

CROSS-LAYER DESIGN IN WIRELESS BODY AREA NETWORKS

There are many optimization literatures for Wireless Body Networks (WBANs). However WBANs have certain unique properties so that the conclusions for general WBANs may not be applied in WBANs. According to the energy constraint for WBANs is even harsher than that of WBANs because the volume of on-body or in-body sensor nodes needs to be tiny and the sensors are hard to be recharged generally. Since excessive radiation absorption will cause damages to the vulnerable body tissues, the transmission power of the sensor nodes and relay nodes need to be constrained. Furthermore, the body channels are highly unstable because of the irregularity of people's movements and the signal absorption incurred by body

tissues. All of these constraints in WBANs make data transmissions hardly reliable. In order to deal with unstable channel status, relay has been proposed as one of the solutions in [10]. In [42, 64], the authors consider using relays to improve the network performance. According to simulation results, relays can reduce the outage rate and power consumption effectively. However, the decision of relay locations, which has profound influence on the performance, has not been discussed. In [2014], an Energy-Aware WBAN Design Model (EAWD) is proposed to address the on-body relay positioning problem. However, only network layer is considered and no 25 cross-layer design is included, which undermines its effectiveness in prolonging network lifetime. Furthermore, the proposed objective is minimizing total energy consumption and may lead to energy shortage for the heavily used nodes quickly. In [74], the authors propose solutions to the energy minimization problem and network lifetime maximization problem based on intelligent time and power resource allocation in WBAN context. Both problems are formulated and solved as geometric programming.

CONCLUSION

This postulation introduces an agreeable based power control game calculation which is used with the social connection data model. So as to deal with the WBAN with the safety efforts to transmit the patient information all through the framework an Elliptic Curve Cryptography (ECC) calculation is utilized for verification before starting the transmission. The presentation of the proposed methodology is assessed alongside the expanded number of hubs while the event of an impedance issue is likewise thorough. The proposed methodology gives the better outcomes where the power is expanded to augment the framework life time of WBAN correspondence through power game methodology, which additionally mitigates the obstruction issue proficiently. The WBAN framework utilizes ECC calculation to perform confirmation, encryption and decoding, which yield better security of patient information to set up the correspondence between the quantities of WBAN. A productive WBAN framework has observing data extraction, high spatial reuse, and probability of progressively calibrating the checking procedure to suit the information quality, arrangement for permitting the interpretation of significant level necessities of restorative officials to low-level sensor reconfiguration. Issues identified with security and potential arrangements must be taken in the examination. This Research proposes an enhanced WBAN handover system, and method to amplify the system throughput by mutually choosing stable courses and allotting channels staying away from between and interflow obstructions dependent on versatility expectation, utilizing multi jump bunching strategy to augment the system throughput by together choosing stable courses and doling out

channels evading between and intra-stream impedances dependent on portability forecast. In our WBAN hub of the correspondence conspire, ECC calculation is applied where the recipient hub is intended to get the data, and the transmitter hub is intended to transmit the data to a legitimate information server.

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