International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 1592-1596 www.ijaem.net ISSN: 2395-5252

Enhancing Throughput Cluster-Based Wban Using Tdma and Cca Schemes

Matthew Iyobhebhe[1],Agburu.O.Adikpe[2],James. G. Bashayi[3], Caleb. A. Amlabu[4], Ishaya. Chollom. Botson[5],Chukwudi. J. Ezugwu[6] and Omojola .B.A[7]

[1,3,4,5,6&7]*Federal Polytechnic Nasarawa, School of Engineering Technology, Department of Electrical/Electronic Engineering.*
[2]*Ahmadu Bello University,Faculty of Engineering, Department of Electronic and Telecommunication.*

Submitted: 15-05-2022 Revised: 20-05-2022 Accepted: 25-05-2022

ABSTRACT
WBAN comprises multiple sensor nodes which are strategically located on patients' bodies, they collect physiological signs and transmit them to the medical personnel for further analysis via a medical server. These sensor nodes are energy-dependent, their source of energy is derivedfrom rechargeable batteries, in order to have prolonged network activities, a well-organized energy
utilization in the network must be highly considered. In this work, we considered the Time Division Multiple Access (TDMA) and Clear Channel Assessment (CCA) scheme to manage the energy utilization in the network to produce network lifetime maximization and a high level of improved throughput with a 6.60% improvement as compared with the existing algorithm.
KEYWORDS: WBAN, Transceiver nodes, CCA, TDMA, Throughput, Sink node.

I. INTRODUCTION

Due to the increment in individual age, the long-standing health maintenance routine might be difficult to view, due to the need for medical services in the times ahead for the ill person because of financial constraints. Because of the inadequate financial means to cater for the ill person/patient, it is unfeasible to provide for medical bills that are ahead, for this reason, WBAN provides a platform for distanceexamining of a patient with a less cost-effective [1]. There is always a constant examination of patients before deterioration sets in. WBAN permits the placement of low-power transceiver nodes in, on, or around the patients to examine patients' conditions regularly. The individual transceiver nodes in the network possess the processing energy and transmit the information to the Cluster Head, thereafter aggregating these packets and sending them to the medical personnel for further analysis via the medical server [2]. Wireless Body Area Network is an integral part of the Wireless Sensor Network, where the protocol that is employed in the wireless sensor network cannot be conveniently utilized by the wireless body area network because of some reasons such as; architecture, data rate, delay, and so on [3,4]. Essential conditions that are necessary for Wireless Body Area Network creates limitations for its blueprint in terms of routing schemes [5]. The routing scheme carries a vital part in the execution of the network such as energy efficiency, latency, throughput, and so on. The sensor nodes in the network are energy- limited, for efficient continual operation of the network, there must exist a well-organized network in such a way that energy utilization must be minimized. In this work, we are employing Time Division Multiple Access (TDMA) and Clear Channel Assessment (CCA) schemes to address the minimization of energy consumption to get prolonged network activities.

11. RESEARCH WORK

In [6], proposed wireless data and energy exchange to maximize data throughput in WBAN. In their work, they concurrently deploy the use of wireless data and energy exchange using a relay in the WBAN. The relay got energy from harvesting from the radio-frequency signal that is transmitted by the nodes and sends the energy to the destination, and forward the data to the source, vice visa. They were able to realize an improved throughput compared to the existing protocol. But they do not consider TDMA and CCA schemes in their work, they would have realized a better throughput than what they got.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 1592-1596 www.ijaem.net ISSN: 2395-5252

In [7], they proposed energy-efficient and reliable for a better throughput for WBAN. In their work, packets are gotten from the nodes that are deployed in the body of the patient, and also power utilization was minimized by employing multi-hop communication and a cost function was used. They realized a high throughput as compared to the existingschemes. But non-consideration of TDMA and CCA schemes degradesthe level of throughput they would have gotten.

prolonged network activities. In this work, we are bringing in Time Division Multiple Access and Clear Channel Assessment schemes to[9], proposed analysis throughput coexistence of physical –cyber wireless body area network alongside with wireless local area network. In their work, they considered IEEE 802.15.6-based WBAN using a spectrum that is unlicensed. Congestion and transmission probability was systematically estimated to enhance link access and coexistence of the networks. But they realized a better throughput compared to the existing algorithm. However, the non-consideration of TDMA and CCA schemes degrades the level of throughput they would have got.

In WBAN which comprises multiple sensor nodes that are energy limited by design, it very imperative to manage the networks' energy consumption, so as to continue in minimise the energy consumption in the system, so that the

In [8], proposed an enhanced throughput by varying multipoint in wireless body area network with even distribution. In their work, the nodes send an authorized signal to the gateway by asking the radio frequency power from the source. Whereas, the nodes that are placed in the patient send the body's vital signs to the gateway node. With this, a better throughput was realized as compared to the existing one. But non-consideration of TDMA and CCA schemes degrades their level of throughput. transmitting packets from a source node can get to their desired destination node. The more we minimize the energy utilization in the WBAN, the more sufficient energy in the entire network and a better throughput of the packets.

1.11. EXPERIMENTATION

A.Sleep Mode Mechanism

The crucial area where energy is normally misused in WBAN is idle listening, that is when sensor nodes are in a state of active mode, yet no packet at the instant of time to transmit. A comprehensive sleep –mode can be activated by putting their transceiver radios off when there is no packet to transmit because transceiver nodes that are not in Active-state will not be able to collect any packet and get the signal command and also, conserved their energy for the period at which it is not transmitting any data.

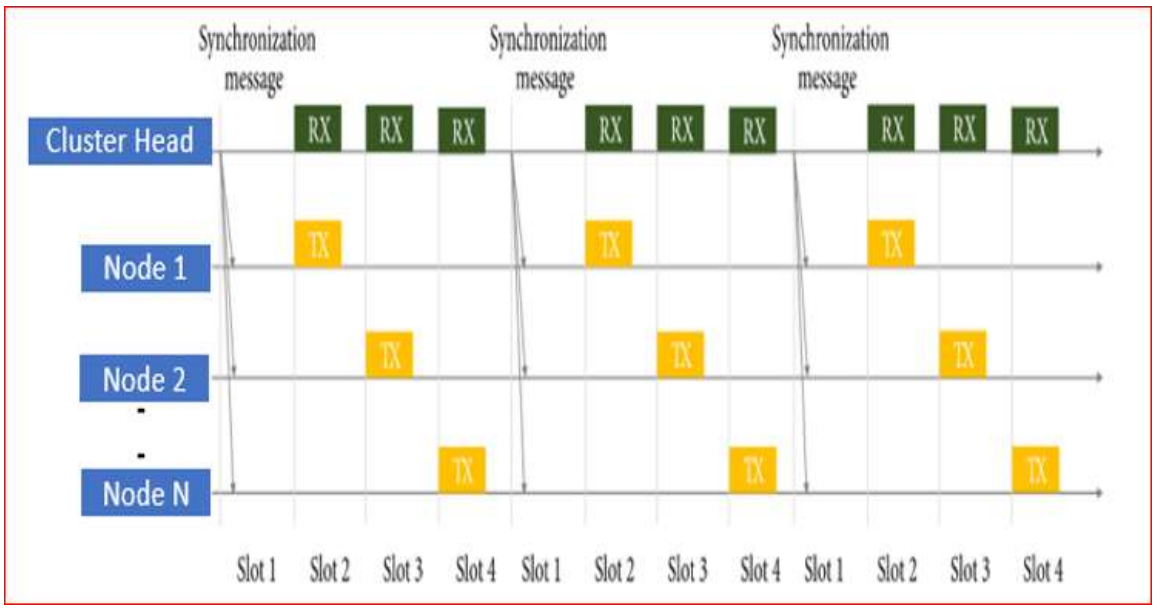

Figure 1: Allocation of Time Slot by Sink Node

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 1592-1596 www.ijaem.net ISSN: 2395-5252

This is the time slot allocation for WBAN communication amongst the transceiver nodes. In this article, the allocation of a time slot to all the member nodes is been executed by the Sink node which adopts Time Division Multiple Access (TDMA) scheme. TDMA allocates a one-time slot to only one channel at a time. Figure 1 depicts the operation of conveying physiological signs from the patient's body in a scheduled time slot based on the signal of the sink node. The sink node conveys a synchronization signal to all members of the nodes in thefirst period. The member nodes receive the synchronization signal, the sequence information of the current packet based on the signal, and transmit the message which contains the health packet and the sequence number to the sink node. This action continues for each node in the cluster. By so doing, energy utilization in the network is minimized, accumulation of the individual sensor nodes energy to the entire network system, and a better throughput and maximization of a network lifetime.

B. Clear Channel Assessment (CCA) scheme.

When the wireless channel in WBANs is idle, the transceiver nodes will commence transmitting data packets [11, 12].

Table 1: Groups of CCA Scheme

CCA Group	Categories
CCA Group 1	Energy detection method [13]
CCA Group1	Carrier sense method only for recognizing the data from same communication standard with different priority
CCA Group3	Hybrid method for recognizing the data from different communication standard with different priority

C. Management of Bandwidth

Packet transmission in WBAN must align itself with the principle of bandwidth management for its effective delivery. In WBAN Uplink and Downlink are not symmetrical. Conventionally, transceiver nodes receive packets and thereafter transmit this packet to the sink node via Uplink. Uplink contains higher packets compared to downlink with a lower packet which is why the period cycle of Downlink is smaller than that of the Uplink. The Downlink is normally utilized when there are sink node commands and information broadcasted from the sink node. The allocation of resources bandwidth scheme in the sink node is responsible for determining the duration of the Downlink [10].

International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 1592-1596 www.ijaem.net ISSN: 2395-5252

Table 2: The Simulation Parameters [14]

Parameter	Value
Simulator	MATLAB 2017
Initial Energy	0.6 J
Minimum supply voltage	1.8 V
Frequency (f)	2.4GHz
$E_{Tx\text{-}amp}$	1.98nJ/bit
$E_{Tx\text{-}CCT}$	16.7nJ/bit
$ER_{x\text{-}CCT}$	36.3nJ/bit
DC current (TX)	10.6 Ma
DC current (RX)	17Ma
Wavelength (λ)	0.138m
Γ_{max}	7

II. RESULT

THROUGHPUT AGAINST NETWORK PROCESSING TIME

In this article, the successful delivery of data packets from the source node to the sink node per unit time is called throughput. Figure 2 depicts the throughput performance of the developed algorithm against the existing DSCB algorithm.

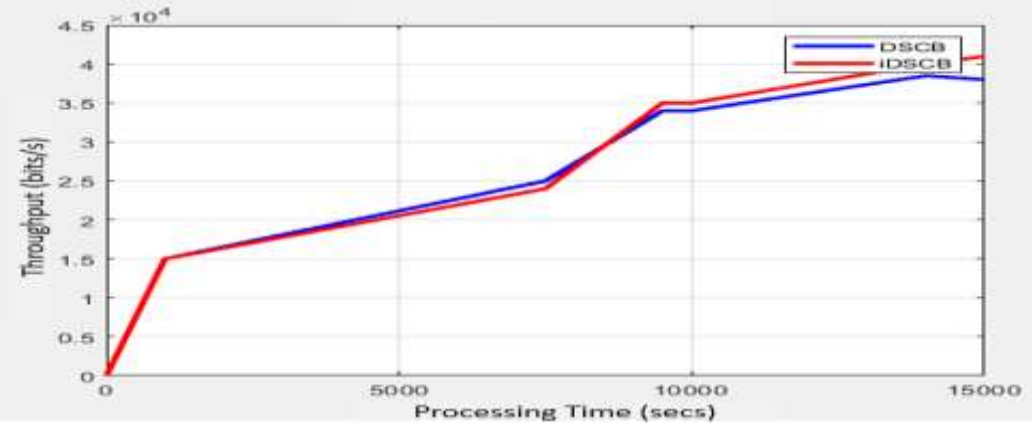

Figure 2: Plot of Throughput against Network Processing Time

It is discovered from Figure 2 that the throughput increases as the network processing time increase for both algorithms. This is due to the use of dual sink nodes that enable more transmission of packets to the Sink node at a given time. Equation (1) was used to generate the plot. However, the iDSCB algorithm shows better throughput than the DSCB algorithm. This is because the developed algorithm considered other parameters such as the node TDMA and CCA schemes in the selection of neighbor nodes for data transmission, whose effect reduces the drop of packets due to high traffic in the node. The iDSCB algorithm shows an improvement of 6.60% when compared with the existing DSCB algorithm. Table 2 shows the percentage improvement evaluation of iDSCB algorithm over the existing DSCB algorithm.

Table 2: Throughput Performance Analysis of DSCB and iDSCB

S/N	Algorithm	Average Throughput	Percentage Improvement Using Equation (3.22)
1	DSCB	2.28	6.60%
2	iDSCB	2.43	

III. CONCLUSION

For effective packet transmission, the need for well-organized energy efficiency in the network must be pertinent. If a particular sensor node is transmitting a packet to the intermediary nodes, and the current energy status node during the

network operation of a certain transceiver sensor is not sufficient enough to carry that packet, the likelihood for that node to experience a dead node is certain, therefore, TDMA and CCA schemes come on board to creates a platform for network energy to be sufficient for a prolong network activities. The percentage improvement of the throughput was on a higher side compared to the existing scheme.

REFERENCE

[1]. Zhang, S., Qin, Y. P., Mak, P. U., Pun, S. H., Vai, M. I. ((2013). Real-time medical monitoring system design based on intra-body communicationJournal of Theoretical and Applied Information Technology20134726496522-s2.0-84872852615.

[2]. S. Ullah, H.. Higgins, B.Latre. C. Blondia.(2012). An extremely low transmit power per node is needed to minimize interference to cope with health concerns and to avoid tissue heating. Medical Journal.48.

[3]. Zahoor Khan, ShyamalaSivakumar, William Philips, Bill Robertson. (2013).“A QoS-aware Routing Protocol for Reliability Sensitive Data in Hospital Body Area Networks”, The 4th International Conference on Ambient Systems, Networks and Technologies, Procedia Computer Science,.19. 171-179.

[4]. Macwan, Stefina, Nikhil Gondaliya, and Nirav Raja. (2016). "Survey on Wireless Body Area Networks.",Internatioal Journal of Advanced Research in Computer and Communication Engineering,. 5(2). 107-110.

[5]. Justin Lipman, SamanehMovassaghi, MehranAbolhasan, . (2013). “A Review of Routing Protocols in Wireless Body Area Networks”, Journal of Network and Computer Applications,.8(3). 559.

[6]. Liheng Wang., Fengye Hu., Zhuang Ling., Bo Wang. (2017). Wireless information and power transfer to maximize information throughput in WBAN. IEEE Internet of things journal. 4(5), 1663-1670.

[7]. NadeemJvaid., Ashfad Ahmad., QaisarNadeem., Muhammad Imran., NomanHauder. (2015). iMproved stable increased-throughput multi-hop link efficient routing protocol for wireless body area network. Computer in human behavior. 51.1003- 1011.

[8]. Cong Liu., He Liu., Yuliag Cong., Pengjie Li., Zhi Mao., HuiHui Zhang. (2020). Throughput maximization by time switching in multipoint WBAN with fairness consideration. IEEE Access. 8. 107661-107668.

[9]. Pradyumna Kumar Bishoyi and SudipMisra. (2018). Coexistence throughput analysis of cyber-physical WBAN system in presence of WLAN. IEEE Globacom Workshops. Doi:10.1109/globacomw.2018.8644341.

[10]. Fang, G., Dutkiewiz.E. (2009). BodyMAC: Energy efficient TDMA-based MAC protocol for WBAN. International symposium on communications and information Technology. Doi: 10.1109/iscit.2009.5341045.

[11]. R. Gummadi, D. Wetherall, B. Greenstein, and S. Seshan, (2007). “Understanding and mitigating the impact of rf interference on 802.11 networks,”. 385-396

[12]. Daniel Jiang and Luca Delgrossi. (2007). Wireless access in vehicular environments. IEEE Standard 802.11.2036- 240.

[13]. Dangi, K., Bhagat, A., &Panda,S.P., (2020). Coexistence modelling of WiFi and ZigBee in hospital centered wireless body area network. Advancement in mathematics and its emerging area. 2214(1).Doi: 10.1063/5.0003373.

[14]. Ullah, Z., Ahmed, I., Razzaq, K., Naseer, M. K., & Ahmed, N. (2017). DSCB: Dual sink approach using clustering in body area network. Peer-to-Peer Networking and Applications, 1-14.