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A REVIEW ON MAC PROTOCOLS IN WIRELESS BODY AREA NETWORKS

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ABSTRACT

Wireless Body Area Network (WBAN) is the most promising technology in E-health applications. Energy efficiency stands out as the predominant issue for WBAN. The crucial attributes for a good MAC for WBAN are listed.. Features of the various MAC protocols qualitatively compared. For designing appropriate WBAN protocol's requirements considered such as reliability, latency and energy expenditure.

KEY WORDS: *WBAN, Energy efficiency, MAC protocol, PTA, Context aware MAC*

1. INTRODUCTION

Wireless body area networks (WBANs) or a body sensor network (BSNs), are wireless networks of wearable computing devices. WBAN devices are planted inside the body, implanted, or surface-mounted on the body in a fixed position i.e. Wearable technology or may be accompanied as devices which humans can carry in clothes pockets, by hand. In wireless body area networks (WBANs) the energy efficiency of the system is a primary prerequisite[fig-1]. A medium access control (MAC) layer addresses the energy efficiency most effectively[1]. It provides the ground for achieving Quality of Service (QoS) in any wireless networks and is core communication

protocol stack. This layer is used to coordinate node access to the shared wireless medium.

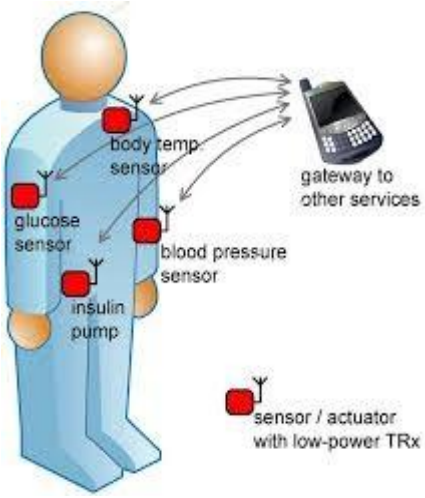

Fig -1 WBAN overview

Different types of MAC should support diversity applications and various characters of data, such as continuous, periodic, burst and non-periodic data along with high level QoS. It also acts as a major role in determining factor for improving overall network performance. The fundamental task provided by MAC protocol is it avoids collisions and to prevent simultaneous transmissions by preserving maximum throughput, minimum latency, communication reliability and maximum energy efficiency. Nodes in networks are prone to node failures and limited energy resources, thus these needs taken into consideration while designing MAC protocols.

2.ATTRIBUTES CONSIDERATION FOR EFFICIENT MAC PROTOCOLS

Several attributes need to be counted for the intention of an energy-efficient MAC protocol for a WBAN. One of the elementary attribute is energy efficiency. WBAN devices are run by a battery requires stringent restriction on the employment of energy resources. To achieve this goal, design of energy-aware communication protocol is affected. Energy-efficiency can be increased by minimizing the energy wasted. WBANs are intended to hold up life saving critical applications. Hence reliability, safety and security are considered important metrics besides energy efficiency. The QoS is also an important factor of a good MAC protocol. Other parameters of importance include scalability, adaptability to changes in network topology, throughput, jitter, latency and bandwidth usage. In case of medical applications, latency should be less than 125ms for QoS. In summary, the attributes of a good MAC in WBAN include energy-efficiency, reliability, heterogeneous traffic, safety and security in addition to QoS.

3. EXISTING MAC LAYER PROTOCOLS

MAC protocols in WBAN are grouped into two major categories based on contention and contention free protocols.
(i)Contention-Based MAC known as carrier sense multiple access/collision avoidance(CSMA/CA) protocols in which node competes for channel to transmit data.(ii)Time Division Multiple Access(TDMA) based MAC protocols are energy efficient protocols. In this technique transmission of packets are managed in the form of time frames and time slots. Here, channels are divided into fixed/variable time slots for each sensor node to transmit during its slot period. Table-1 shows detailed comparisons with existing MAC protocols in context of WBAN.
S-MAC[4] and B-MAC [6] protocols are suitable for normal traffic applications. T-MAC[5] protocol has adaptability to changes in traffic condition is good. P-MAC[7] protocol is designed for purpose of delay sensitive applications. D-MAC[8] protocol is designed for low delay applications. LEACH[9] protocol and HEED[10] protocol in which WBAN coordinator can act as a cluster head.

Table-1.Comparison of MAC Protocols in the context of WBAN

PROTOCOLS	MAC Techniques	BENEFITS	DRAWBACKS
S-MAC[2]	CSMA / Scheduling	Simplicity, high latency, time synchronization overhead is prevented due to sleep schedules	Low throughput, collision due to packet is not destined to listening node
T-MAC[3]	CSMA / Scheduling	Packets are sent in burst, better delay, gives better result under variable load	Sleep mode problem
B-MAC[4]	CSMA / Scheduling	Simplicity, good packet delivery rate, high throughput, low overhead	Overhear-ing problem is not solved, long preamble increases the power consumption
P-MAC[5]	CSMA / Listening	High throughput	Adaptation to changes might be slow
D-MAC[6]	CSMA / Scheduling	Good delay performance, energy-efficient	Collision avoidance are not utilized, leading to collisions
LEACH [7]	TDMA / Clustering	Distributed protocol, requiring no control information from the base station	Extra overhead for dynamic Clustering
HEED [8]	TDMA / Clustering	Low overhead, Scalable prolonged network lifetime	Cannot guarantee optimal set of cluster heads

3.1 Energy Efficient MAC Protocol

The MAC protocol proposed by IEEE 802.15.6 Standard[9] divides the channel into beacon periods or super frames of equal length. Each beacon period contains a number of allocation slots used for data transmission. The hub transmits beacons to define the beacon period boundaries and the slots allocation. Generally, the hub transmits beacons in each beacon period except those that are inactive. Three traffic types in a WBAN: i)Traffic which is the set of packets sent by nodes Normal with a frequency pre-established; ii) On-demand traffic which is the set of packets sent by nodes as an answer to the requests made by the hub and iii) Emergency traffic which is the set of packets generated by all kind of alerts like medical emergency alerts, low battery alerts or buffer alerts. There are three proposed phases for each beacon period. 1)Slot reallocation phase. 2) Managed Access Phase. 3)Management and Emergency phase as shown in fig-2.

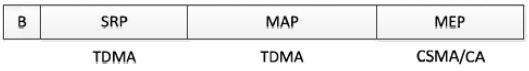

Fig -2 Phases in beacon period

Advantages-Proposed MAC protocol[11] is designed in order to increase quantity of packets in normal and emergency traffic. And improved power consumption for each sensor nodes.

Disadvantages- Normal latency has to be improved without the impairing of the emergency latency and energy consumption as well.

3.2 QUASI-SLEEP-PREEMPT SUPPORTED MAC Protocol

It is TDMA based MAC protocol where nodes deployed in topology transmit packets to parent nodes in assigned slots and enters into Q-sleep mode in other slots. For normal transmission, QS-PS[10] runs based on TDMA and for emergency packet transmission it will broadcast awakening message to all nodes in Q-sleep mode. In Quasi-sleep mode node will enter into sleep mode when dedicated slot elapses and wakes up for next assigned slot. Fig 2. shows comparison of conventional and new sleep patterns.

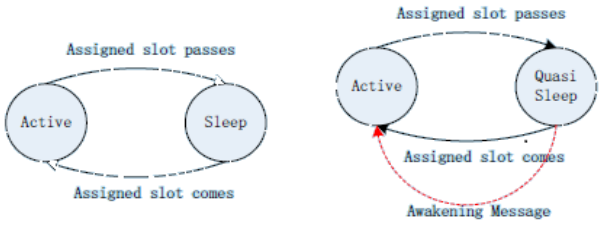

Fig -3 Two active sleep patterns

Advantages - It achieves high energy efficiency and provides low delay service for both normal and emergency transmission of packets.

Disadvantages - Need to be assigned for more specified time slot reallocation in awakening mode.

3.3 Energy Efficient Context Aware MAC protocol

The Context Aware MAC protocol[11] is implemented based on IEEE 802.15.4 MAC layer protocol which incorporates congestion awareness and it is also called as Low Rate Wireless Personal Area Networks(LR-PAN).Context is based on channel condition and congestion.

Advantages - The enhanced CA-MAC protocol performs better than traditional MAC because of higher packet delivery ratio and throughput. Less control overhead, jitter and delay when compared to 802.11 MAC protocol.

Disadvantage - Error correction mechanism as to be implemented for successful delivery of data.

3.4 Priority Based Adaptive Timeslot Allocation(PTA) scheme for WBAN

The authors[12] proposed a priority based adaptive time slot allocation scheme is based on priorities of data traffic grouped into medical, non medical and emergency data shown in Table-2.The Contention Access Period(CAP) is divided into three phase 1,phase 2 and phase3 as shown in Fig-3.Phase-1 can be used in transmitting C1 type of data, phase-2 both

C1 and C2 type of data and phase-3 can be used in transmitting all kind of data. The emergency data are delivered during CAP period through CSMA/CA approach.

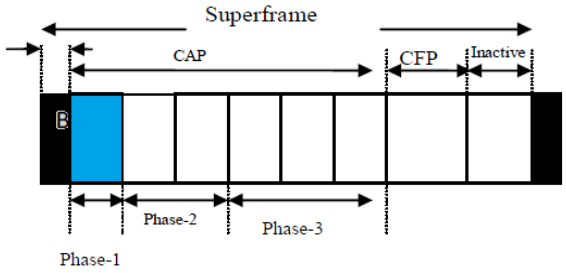

Figure-3 Superframe of PTA scheme

Advantage – In this protocol due to data priority QoS can be achieved and is able to cope up with dynamic network size.
Disadvantage – In order to achieve energy efficiency, acknowledgement of packet delivery is disabled thus, no guaranteed transmission of packets.

Table-2 Priority of Data

Priority	Symbols	Data Type	Example
1	C1	Emergency alarm	Emergency vital signals
2	C2	Continuous/Discontinuous medical	EEG/EMG Temperature/B.P.
3	C3	Continuous non medical	Audio/Video

4.CONCLUSION

In this paper, a review on MAC protocols for WBAN is shown. Various approaches of WBAN MAC protocols are compared and listed in tabular column. Most of MAC protocols proposed primarily focuses on reliability, latency and energy expenditure. None of the work has been proposed further till cross layer optimization. A lot of work needs to be packed out in layers like data link layer, network layer and cross layer optimization are most promising research areas for future work.

REFERENCES

[1] T. Zheng, S. Radhakrishnan, and V. Sarangan, "PMAC: An adaptive energy-efficient MAC protocol for wireless sensor networks", In Proc of the 19th EEE Int.Parallel and Distributed and Processing Symposium (IPDPS'05), pp. 65-72, Apr 2005.

[2] W. Ye, J. Heidemann, and D. Estrin, "An energy-efficient MAC protocol for wireless sensor networks", In Proceedings of the IEEE Infocom, New York, USA, pp. 1567-1576, Jun. 2002.

[3] T. Van Dam and K. Langendoen, "An adaptive energy-efficient MAC protocol for wireless sensor networks", In ACM Conference on Embedded Networked Sensor Systems (Sensys), Los Angeles, USA, pp. 171-180, Nov. 2003.

[4] J. Polastre, J. Hill, and D. Culler, "Versatile low power media access for wireless sensor networks", In ACM Conference on Embedded Networked Sensor Systems (Sensys), Baltimore,
Maryland, USA, pp. 95-107, Nov. 2004.

[5] Khan, N.P.; Boncelet, C., "PMAC: Energy efficient medium access control protocol for wireless sensor networks", In Proceedings of IEEE Military Communications Conference, Washington, DC, USA, 2006;pp.1-5, 23-25.

[6] Lu, G.; Krishnamachari, B.; Raghavendra, C, "An Adaptive Energy-Efficient and Low-Latency MAC dor Data Gathering in Sensor Networks", In Proceedings of the 4th International Workshop on Algorithms for Wireless, Mobile, Ad Hoc and Sensor Networks, Santa Fe, Mexico, 2004.

[7]G. Pei and C. Chien, "Low power TDMA in large wireless sensor networks", IEEE Military Communications Conference (MILCOM), pp. 347-351, Oct. 2001.

[8] O. Younis and S. Fahmy, "HEED: A hybrid, energy-efficient, distributed clustering approach for adhoc sensor networks", IEEE Transactions on Mobile Computing, vol. 3, no. 4, pp. 366-379, Oct. 2004.

[9] Richard Jaramillo, Alejandro Quintero, Steven Chamberland "Energy-Efficient MAC Protocol for Wireless Body Area Networks" 978-1-4799-6908-1/15 IEEE.

[10] Liu Jing1,2,3, Li Ming1, Yuan Bin1, Liu Wenlong "A Novel Energy Efficient MAC Protocol for Wireless Body Area Network" China Communications • February 2015.

[11]Aparna A R "An Enhanced Energy Efficient Context-Aware Medium Access Control Protocol for Wireless Body Area Networks",International Journal of Innovative Research in Computer and Communication Engineering, Vol. 3, Issue 10, October 2015.

[12] Shuai, J., Zou, W. and Zhou, Z. 2013, September. Priority-based adaptive timeslot allocation scheme for wireless body area network. In Communications and Information Technologies (ISCIT), 2013 13th International Symposium on(pp. 609-614). IEEE.