Volume-4, Issue-5, May-2015 • ISSN No 2277 - 8160

Research Paper | Engineering

Review of Mac Protocol Using Contention Window for Wireless Body Area Network

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ABSTRACT *Wireless Body Area Network focus on the MAC layer which is a sub layer of the Data link layer. In this layer the bits are organized into frames to provide hop-to-hop delivery. To reduce the collision when more than two nodes tries sending data on the same channel Back off algorithm is proposed. In this work a dedicated control channel is designed for its application. The priority algorithm sets the traffic priorities and the traffic is then classified based on the priority. Concept of contention window is used to assign values to nodes for resource allocation.*

KEYWORDS : MAC; WBAN; Contention Window

I. Introduction

The increase in population and health cost are catalysts to innovation in health care. These factors along with the advances in the field of electronics and wireless communication methodologies have led to the development of Wireless Body Area Networks (WBANs).

Wireless Body Area Network is a sensor network concept that has evolved over the last few years with the idea of monitoring vital physiological signals from in-body or on-body sensors and a central coordinator. The signals are sent to the coordinator, which processes the data then transmits it to remote medical database servers without much interference to the daily routine of the patient. WBAN is one of the most promising approaches in building wearable health monitoring systems. WBANs have been considered not only for medical and healthcare applications but also for sports and entertainment applications.

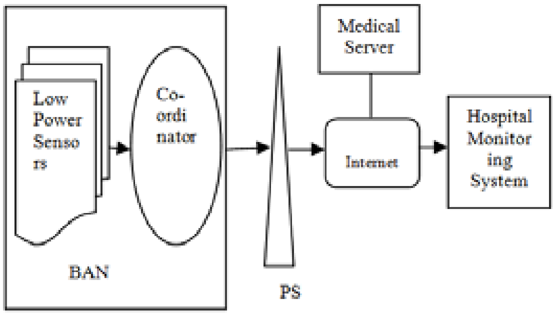


Fig. 1 Basic WBAN Architecture

Medical Server

The medical server stores electronic patient records in a database, summarizes physiological data and automatically analyzes the data to verify it is inside or outside acceptable health metrics (heart rate, blood pressure, activity) and identifies known patterns of health risks. The medical server interfaces the electronic patient records and insert new session data, generate alerts to the physician and emergency health care professionals when abnormal conditions are detected. This is especially powerful for the physician who can access the data at a convenient time to determine whether the patient is responding to a prescribed medication or exercise and make updates to those prescriptions and forward them electronically back to the patient.

Personal Server (PS)

The personal server, at the second tier, is responsible for interfacing with the medical server via the Internet, interfacing the WBAN sensors and sensor data, and providing a graphical or audio interface to the end user. For in-home monitoring of elderly patients, a stationary residential gateway or personal computer might be the ideal platform, but for high mobility users, it may be necessary to use a smart phone or handheld computer with GPRS capabilities. The personal server requires ZigBee or Bluetooth capability for communications within the WBAN; depending on the platform, this may be integrated in the device or provided as a separate plug-in network coordinator (NC). In addition, the personal server is responsible for type and number of sensors, specify sampling frequency and mode of operation. Once the sensor nodes are configured, the personal server fuses sensor data into personalized session files. Based on the information from all medical sensors, the PS application should find out the user's health status, providing user feedback through a graphical or audio user interface.

For interface to the medical server, the personal server requires some wireless wide area network (WWAN) or wireless local area network (WLAN) access such as GPRS. In the case of a static residential gateway or home personal computer implementation, the personal server may be connected directly to a broadband Internet link. The personal server has patient authentication details and is configured with IP address of the medical server so that it can access services over the Internet. The PS schedules upload of health monitoring session files at periodic intervals. [1]

II. Related Works

Deze Zeng and Song Guo [2] have proposed a scheme to improve the energy efficiency and throughput. The WPAN coordinators are aware of network coding. Some issues related to guarantee time slots allocation and multicast is used to perform efficient network coding. This protocol is valid for star-based networks and can be easily applied to intra-session network coding in multi hop IEEE 802.15.4 WPANs.

Sana Ullah et al. [3] have proposed a hybrid and secure MAC protocol for WBAN where two contention access periods (CAPs) are used for normal and life-critical traffic and a contention-free period (CFP) for large amount of data packets. In CAP period, priority-guaranteed CSMA/CA procedure is used in which various priorities are assigned to each node in WBAN by adjusting the size of the backoff window. In order to prevent illegal access to the network, a set of security keys is used. The various parameters are analyzed.

Yan Zhang and Guido Dolmans et al. [4] have proposed a priority-guaranteed MAC protocol. For consumer electronic applications, data channels and control channels are separated to minimize the collisions and obtain high data rate communication. In order to provide priority guarantee for life-critical medical applications, priority-specific control channels are used. Traffic-specific data channels can improve resource efficiency and latency performance. An asynchronous wakeup trigger mode for priority traffic can minimize energy consumption and access latency.

Nourchène Bradai, Lamia Chaari Fourati, Saadi Boudjit, Lotfi Kamoun [5] have proposed a hybrid medium access control protocol, named Priority MAC (PMAC), that depends on the integrated super frame structure of IEEE 802.15.4 and IEEE 802.15.6. The data channels are separated from control channels. After that, the priority is given to the emergency traffic. PMAC utilizes flexible and efficient bandwidth allocation schemes. The bandwidth allocated in TSRE and TSRN can be changed in each MAC frame to meet the requirements of nodes. A sleep mode can conserve energy of the wearable wireless sensors and extend their lifetime.

III. Problem Identification

Our previous work includes fault-tolerance and no data loss in WBAN data transmission, An adaptive cooperative data transmission technique was designed [6]. In WBAN, the loss of data during transmission is avoided by using multiple relays which collect data from the various sensors and transmit this data to the receiver. Each control node maintains a priority queue in which the data with smaller fault tolerant value is given higher priority. Then, only for these higher priority data, transmission is done with the help of relay nodes applying network coding technique so that the degree of data loss can be reduced. Using this adaptive data transmission technique, fault-tolerance is attained and the overhead involved in the cooperative transmission is reduced.

As an extension to this work, we propose to design an adaptive MAC protocol to increase the throughput while reducing the delay and energy consumption.

IV. proposed solution

The study is focused on the MAC layer which is a sublayer of the Data link layer. The data link layer transforms the physical layer, a raw transmission facility, to a reliable link. Other responsibilities of the data link layer are Framing, Flow control, Error control and Access control.

To avoid the fore mentioned problems, we propose to develop a technique called Traffic priority based MAC protocol (TPMAC) for wireless body area networks to support the QoS requirement in WBAN. In this work a dedicated control channel is designed for its application. The priority algorithm sets the traffic priorities and the medical traffic is given highest priority, then the contention window assigns values to the node for resource allocation.

V. Concept of Contention Window

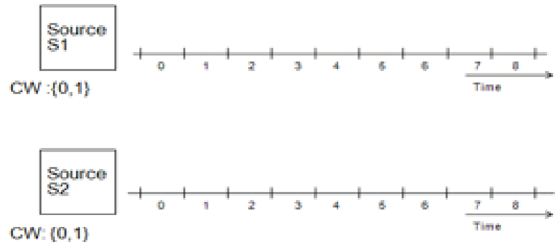
IEEE 802.11 specification requires all nodes to select a random back off integer between zero and CW, wait for the chosen number of time slots before trying to access the channel. Initially, CW is set to CWmin. However, after a collision occurs CW size is doubled, which is denoted by CWmax. This technique is used to reduce collisions.

Research shows that the Back-off algorithm tries to improve the performance to reach the optimal waiting time. When the node wants to transmit data first it senses the channel, if the medium is free, the node will send the data. Otherwise, the node will wait for a random period of time before sending. The concept of contention window is illustrated by the following steps.

STEP-1

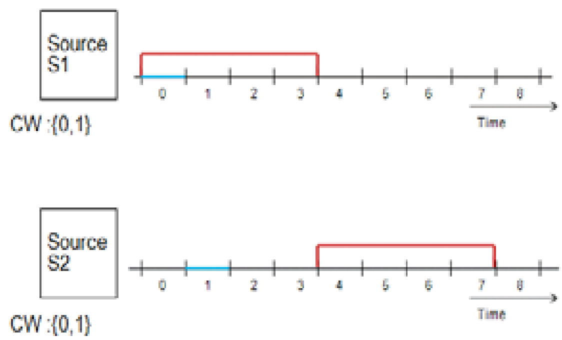
Assume first collision took place, The initial contention window for two sources is {0, 1}

STEP-2



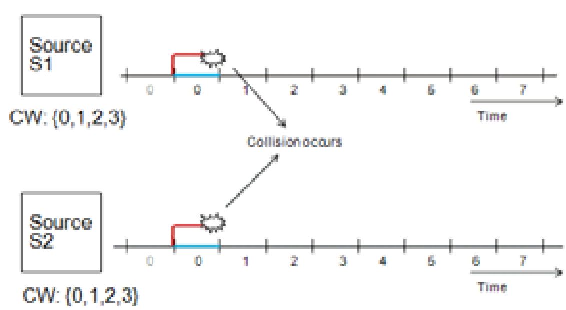
After a collision, time is divided into discrete slots. The frame length is much larger than the slot size. A single slot is sufficient to detect a collision.

STEP- 3



Ideal case that S1 and S2 picks different slots randomly for the transmission of the frame. Suppose S1 picks 0 and S2 picks 1, S1 starts sending the frame in slot 0. S2 should start sending the frame in slot 1 but it hears the channel is busy and waits till the channel is free.

STEP- 4



Suppose S1 and S2 picks the same slot number 0 to transmit the frame, they collide again. After second collision, the contention window changes to {0, 1, 2, and 3}

VI. MEDIUM ACCESS CONTROL LAYERS

MAC can be referred as the sub-layer of data link layer that determines who is allowed to access the media at any given point of time (ex: CSMA/CA/CD). It provides channel access control mechanisms allowing several network nodes to share the medium. The MAC layer also determines the start and end of a frame – frame synchronization.

A. *Contention Based MAC Protocol (CSMA/CA)*

In this protocol the nodes need to perform clear channel assessment before transmission of data. If the channel is busy, the node defers its transmission till it becomes idle. Its infrastructure-free and has good adaptability to traffic fluctuation.

B. Schedule Based MAC Protocol (TDMA)

In this protocol the channels are divided into fixed/variable time slots which are assigned to nodes that transmit during its slot period. Free of idle listening, overhearing and packet collisions because of the lack of medium competition, But require tight time synchronization.

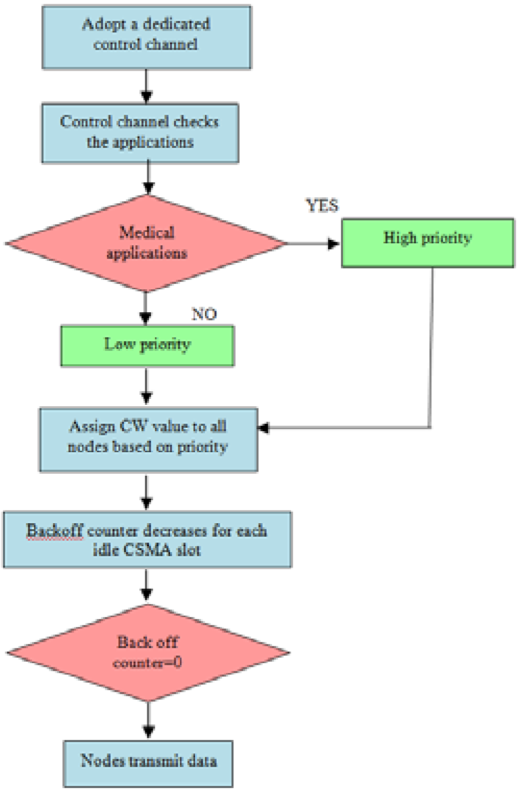


Fig. 2 Flow of TPMAC model in WBAN

VIII. CONCLUSION

The proposing technique, Traffic Priority based MAC protocol will satisfy the QoS requirement in Wireless body area network. Initially, a dedicated control channel assigns high priority to medical applications and lower priority to non-medical applications. Then, priority based slot allocation is performed by using contention window technique. The proposed technique will be a simulation based that compares with an existing technique. The performance evaluation will be based on throughput, delay and energy consumption.

REFERENCES

[1]An Implementation of a Wireless Body Area Network for Ambulatory Health Monitoring by Chris Otto. | | | [2] Deze Zeng & Song Guo. "Energy Aware MAC Protocol for Wireless Personal Area Networks." Aware computing (ISAC).IEEE, pp 171-176, 2010 | | [3]Sana Ullah, Muhammad Imran & Mohammed Alnuem, "A Hybrid And Secure Priority Guaranteed MAC Protocol for Wireless Body Area Network." International Journal of Distributed Sensor Networks, pages 7, 2014. | | [4] Yan Zhang & Guido Dolmans, "Priority-guaranteed MAC protocol for emerging wireless body area networks", Springer-Verlag 2010. | | [5] Nourchène Bradai, Lamia Chaari Fourati, Saadi Boudjit & Lotfi Kamoun . "New priority MAC protocol for Wireless Body Area Networks." Proceedings of the 3rd ACM MobiHoc workshop on Pervasive wireless healthcare, 2013. | [6] P. Meena Priya Dharshini & M.Tamilarasi, "Adaptive Reliable Cooperative Data Transmission Technique for Wireless Body Area Network". IEEE, pp 1-4, 2014.