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A Review of Mac Protocols for Wireless Body Area Networks

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Abstract*: This paper represents broad study of MAC protocols built-up for wireless body area networks. In Today's world data is constantly evolving to process larger data sets and maintain higher degree of connectivity. At same time, advances in efficiency allow for amplified mobility and openness. Body Area Networks signify the liable union among connectivity and smartness. A Body Area Network (BAN) is defined officially as a scheme of devices in close proximity to a person's body that collaborate for the benefit of the user. The enhancement in average lifetime and fitness cost in many developed nations are the main reasons for innovation in health care. Various applications and requirements of the WBAN are discussed in his paper. Also, the strengths and weakness of the protocols have been discussed.*

Keywords*: Wireless body area networks (WBAN), Collision, Energy consumption, medium access control (MAC), Sensor networks.*

I. Introduction

Wireless body area network is a rising skill which has involved the interest of the various researcher's application developers and system designers. Wireless Body Area Network (WBAN) represents advancement of sensor technology for the development of Human-Computer Interfaces (HCIs) that provide natural and context-aware access to personalized services. Various small and intelligent devices medical sensors can be developed with the help of the sensor technology which can be either worn or implanted in human body [9]. With the help of these bio-sensors psychological parameters like heart beat rate, body temperature, blood pressure etc. can be measured.

WBAN allows the use of sensor nodes to monitor the human body functions. Sensors measure various parameters and communicate with the monitoring stations which are located externally for diagnosis. Sensor nodes usually consists of implantable or wearable biosensors such as ECG, phonocardiography (PCG) and ambulatory blood pressure (ABP) and oxygen saturation (SPO2) sensors etc. For communication between devices we require protocols which should be energy efficient. Various algorithm and protocols have been proposed for traditional (Wireless Sensor Networks) [1].

WBAN is composed of micro sized intelligent devices inside or on body of patients connected through wireless links. These micro sized devices belong to two categories sensors and actuators. Sensors measure various internal and external parameters like pulse rate, body temperature, ECG etc. Actuators take actions on the basis of the values collected from the former [2].

II. Applications Of Wbans

2.1 Health Monitoring

To measure the various psychological parameters sensors are applied on the human body which stores the health and motion information in real time and is transferred to the nearby storage devices from their send to the doctors for further processing [3].

2.2 Battlefield

In military to watch the actions of the soldiers and in sports for accurate feature drawing out of the player's activities sensors can be worn on hands and elbows.

2.3 Individual Information Sharing

Different in body sensors can be applied to store the information related to daily life applications or motions[4].

2.4 Recognition

It involves biometric system which is used to recognize person's identity through its facial prints, finger prints and iris recognition.

Furthermore WBAN offer many other services in health care applications like it is used to detect cardiovascular diseases, cancer detection, asthma also used in Telemedicine system and artificial retina [5].

III. Requirements Of Wbans

3.1 Achieving Maximum Throughput

Different applications have different throughput tendency. Some network applications can process a large amount of data high speed while others require a lot of processing.

3.2 Real-Time Processing

Body area networks focus on many such applications which require a quick response from the diagnosis team instantaneously upon data entry or receipt of command [6].

3.3 Minimum Delay

In the network the detective events must be reported immediately in real time so that appropriate actions could be taken immediately.

3.4 Maximize The Network Lifetime

Batteries implanted in the sensor nodes should be able to maximize the network lifetime as sometimes the sensor nodes are implanted at those which are not easy to reach. Energy efficiency should be increased by minimizing the energy wastage [4].

3.5 Quality Of Service (Qos)

Network should have the capability to provide better service to the particular network with respect to error rate, throughput, transmission delays, availability etc. MAC layer plays a vital role to achieve high QOS [7].

3.6 Scalability:

Network should be able to handle the load given to it. Easy construction of WBANS by adding or removing sensor nodes is required to support scalability.

IV. Sources Of Energy Wastage

The above mentioned requirements can be achieved by minimizing the sources which cause energy wastage.

Collision

When two or more nodes try to send data simultaneously collision takes place in between the transmission. The collided packets have to be discarded and the retransmission of packets takes place which results in increase energy consumptions. Collision increases latency also [6].

Idle Listening

When no packet is send over the network then the nodes will be in idle state or most of their time so a Mac protocol designed should be able to reduce the energy wastage due to idle listening and over hearing.

Overhearing

When a packet is send for some other node but it is taken by the node for which it is not intended. Nodes keep listening all the transmission and results in listening to the transmission of the neighboring nodes. This is a significant waste of energy, especially when node density is high and traffic load is heavy.

Control Packet Overhead:

Packet overhead is the time it takes to transmit data on a packet switched network. Each packet requires extra byte of information that is stored in the packet header, with the assembly and disassembly of packets to reduce the overall transmission speed of the data [4].

V. Classification Of Power Efficient Mac Protocols

For extending the life of the sensor nodes several low powers MAC protocols have been proposed, which focus on improving fairness, latency, bandwidth utilization and throughput. The most important need of a good MAC protocol is energy efficiency. There are some application areas where devices need a battery life of months and years without being stopped where as some apps requires a life of hours [8].

These MAC protocols can be classified categories contention based and scheduled based and low power listening protocols. The most challenging task is to implement the low power MAC protocols for WBAN. In humans nodes can be accommodated on body and in body, where the signal propagations are affected by the electrical property of the body. MAC is a sub layer of the data link layer of OSI model. MAC provides the medium access control which is a channel access control mechanism [2].

5.1 Contention Based Mac Protocols

Contention based Mac protocols involve carrier sense multiple access/collision avoidance CSMA/CA protocols. In CSMA protocol nodes competes for the channels to transmit data and perform CCA i.e. clear channel assessment before transmission. However this CCA is not always performed for ex: in the MICS band, where the path loss is higher. CSMA encounters many collision problems for high traffic. CSMA/CA is aalteration of CSMA algorithm to avoid packet collision. Ready to Send (RTS) and clear to send (CTS) are used in CSMA/CA before packet transmission. Packets are transmitted again if the channel is sensed busy [8].

5.2 Schedule Based Mac Protocols

Contention Free MAC protocols involve TDMA, it is a energy conserving protocol as there are no collisions between the nodes during data transmission, nodes are given time slots. Nodes transmit the data on their given time slot. With the help of the guaranteed time slots transmission latency has been reduced. It is the approach used for low mobility and small number if sensor nodes and periodic data generation [8].

5.3 Low Power Listening (Lpl) Mac Protocols

Nodes periodically listens the channel. Channel is periodically sensed by the sensor nodes. Nodes go to sleep mode if it is sensed idle, or keep the transceivers in active mode to receive all the data packets. This is called as polling. Time interval is divided into idle and wake up interval [16]. As the idle interval nodes wakes up to listen the long preamble transmitted by the network coordinator. The network attains the address of the polled node. As the node receives the preamble with its address, either it transmits the data packet or null packet indicating that the buffer of the node is empty [9]. Ex: Wise-Mac.

Table.1. Classification of MAC Protocols

Power efficient Mechanism	Basic Operation	Advantage	Disadvantage
Contention based (CSMA/CA)	(CSMA/CA) have their nodes contended for channel access prior to transmission.	Collision of the data is avoided, Low delay, reliable communication.	Extra energy utilization for collision detection and collision avoidance
Schedule Based (TDMA)	Access to the channel is divided into time slots that are of fixed or variable duration	Collision free, low overhearing, Low duty cycle operations.	Need to pay an extra energy cost for time synchronisation, non-adaptability and scalability.
Low Power Listening (LPL)	Uses preamble sampling technique for communication between the nodes	Reduce idle listening using non-persistent CSMA and preamble sampling technique.	Sensitive to traffic rates which results in degradation of performance in the scenario of highly varying traffic rates.

VI. Existing / Proposed Mac Protocols For Wbans

The most challenging task is to design and implement the low power Mac protocols for WBAN. In humans nodes can be accommodated on body and in body, where the signal propagations are affected by the electrical properties of the body. Mac is a sub layer of data link layer of OSI model and provides the medium access protocol, which is a channel access control mechanism. Mac layer also add and remove frames from the network.

BAN has to handle real time communication with the relatively high supply rate from some sensors such as ECG. It is important that data are sent out before being drop due to buffer overflow considers the limited buffer size. Various MAC protocols have been proposed to reduce the energy consumption.

S-Mac

S-Mac stands for sensor MAC protocol. The main aim of sensor MAC protocol is to decrease energy consumption, and to provide good scalability and collision avoidance. SMAC consists of three major components: collision and overhearing avoidance, periodic listen and sleep, and. SMAC allows the nodes to communicate within fixed time slots, as per the schedule [9]. SMAC deals with the trade off energy for latency. No priority is given to the emergency traffic. It was designed to handle the idle listening problem which is the main source of energy wastage through the adoption of periodic sleep and wakeup schedules.

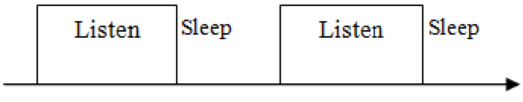


Fig.2. Periodic listens and sleeps

Several senders' tries to send the data to the receiver at the same time, and collisions should be avoided while accessing the medium. To handle the hidden terminal problem RTS/CTS mechanism is used. SMAC adopts a contention-based scheme. Packet transmitted by a node is received by all its neighbors as it has been send for only one of the intended receiver. Due to overhearing contention-based protocols less effectual in energy than TDMA protocols. In SMAC overhearing is avoided by making nodes go to sleep which causes interference [10].

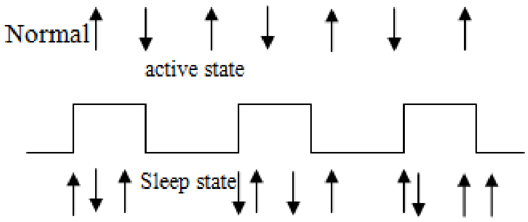
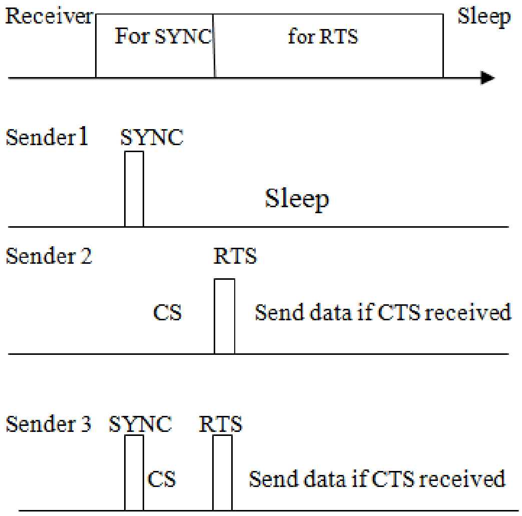


Fig.3. the S-MAC duty cycle

Here message is divided into fragments and is transmitted in burst. For transmitting the entire fragments one RTS packet and one CTS packet is reserved over the medium. Sender waits for an ACK from the receiver when data fragment is transmitted.



CS: Carrier sense
Fig.4.Timing relationship between different senders and receivers

If ACK is not received, it will increase the time of one more fragment which is reserved for transmission, and re-transmit the current fragment instantly.

T-Mac

TMAC is an improvement on SMAC by introducing adaptive duty cycle that can adapt to different traffic patterns and avoid useless wakeups. Node wakes up periodically to communicate with its neighbors and then go to sleep again until the next frame arrives. In the intervening time, new messages are queued. Nodes interact with each other using a Request-To-Send (RTS), Clear-To-Send (CTS), and Data, Acknowledgement (ACK) scheme, which grant both collision avoidance and reliable transmission.

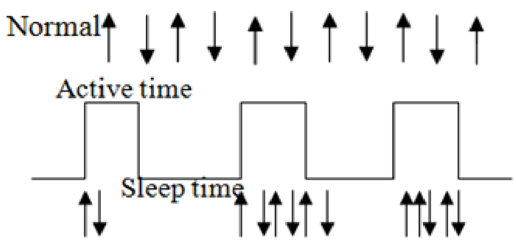


Fig.5. T-MAC protocol with adaptive times

When node is in active period it will keep listening and transmitting. When no activation period occurs for a time TA the active period ends. Node will get in the sleep mode if it is not in an active period. Hence,TA determines the least amount of idle listening per frame[11].

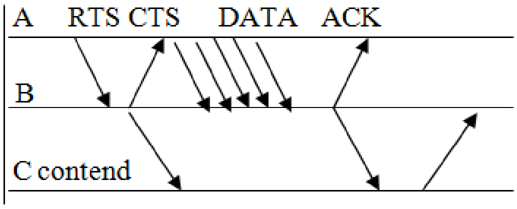


Fig.6. Exchange of data between different nodes. Node C overhears the CTS from node B and will not disturb the communication between A and B. To hear the CTS TA must be long.

Nodes wake up for a definite period of time, if at that time there is no activation, the node goes to sleep. Sometimes nodes may also goes to sleep while their neighbors still have the data to send. TMAC was able to improve the throughput and end- to end latency.

D-Mac

DMAC is directional MAC protocol and has an adaptive duty cycle support only one kind of communication and solves the problem of sleep schedule of nodes by adjusting duty cycle adaptively. The traffic adaptive wakeup method is proposed, in which the sleep period of the sensor node is determined by the amount of time it need to transmit traffic. DMAC attains lower computational requirement in the master node and higher energy efficiency in the sensor nodes. This protocol uses a carrier sensing method to avoid collisions rather than using a collision avoidance method. In the traffic adaptive wakeup stage sensor node acquires its priority. Whether the channel is idle or not is checked by the sensor node through wakes up mechanism also check its varying carrier sensing time depending upon its priority, and if the channel is idle it transmits the data [12].

L-Mac

LMAC stands for lightweight MAC (LMAC) protocol that takes into relation the physical layer properties. Time slots have traffic control section and a fixed length data section. It is a simple schedule based MAC protocol which uses round robin technique is followed by the nodes to send data. The main aim of the protocol is to decrease the number of transceiver switches, to limit the complexity of implementation and to make the sensor nodes sleep interval adaptive to the amount of data traffic. LMAC operation is not based on a central manager or base stations. Time slots can be chosen by the nodes in the network, on the basis of local information only [13]. To save the additional preamble transmission energy costs data unit and control message are transmitted directly after each other. To exchange the data nodes do not need to use handshaking mechanisms. In this way number of transceiver state switches can be kept at a minimum. LMAC protocol extend the network lifetime.

Er-Mac

ER-MAC, based on TDMA is a distributed energy aware MAC protocol and avoiding extra energy wastage is natural. ER-MAC introduces the concept of energy critically of sensor nodes. To balance the energy consumption protocol allows more critical nodes to sleep longer. It also suffers the problem of overhearing. As, two nodes do not transmit in the same slot so packet loss due to collisions is absent. Packet can be lost due to other reasons like loss of signal strength, interference etc. As the slots are pre assigned it doesn't uses any contention mechanism for sensing. Periodic listen and sleep concept is used by ER-MAC [14].
ER-MAC uses the concept of periodic listen and sleep. The key feature of our protocol is the by which the most critical node is chosen To get away from idle listening most critical node is chosen by leader election method.

Battery Aware Tdma Protocol

To maximize the lifetime of the network a cross layer designed MAC protocol have been proposed with cross layer design. Various parameters have been taken into account to access the medium electrochemical properties, packet queuing, time varying wireless fading channel. Its working is similar to IEEE 802.15.4 beacon enabled mode, where nodes listen to the coordinator for the beacons. The time axis is divided into three parts; beacon slot, active time slots and inactive period [7].

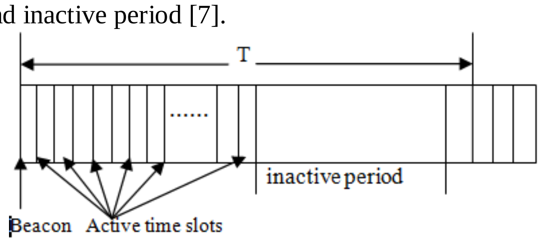


Fig. 7. TDMA frame structure

According to the application requirements frame length can be changed. At the beginning of beacon period sensor nodes wake up. To transmit data in active period every node has its own time slot Ts to transmit data after receiving beacon. To avoid extra energy consumption nodes remain in sleep mode. With the help of GTS we can achieve the reliability and delivery of the packets can be done on time. It has no mechanism to handle the emergency traffic.

Energy Efficient Low Duty Cycle Mac Protocol

Static nature of BAN and TDMA approach are being utilized efficiently to maximize the network life. Body nodes send data to master nodes which communicate with a monitoring station (MS). Data received is analyses by MS while the on- body network communication and synchronization is being performed by MN. Frame is divided into multiple time slots. Time slot S1 to Sn are allocated to sensor nodes while time slots RS1 to RS2 are reserved and are assigned when requested.

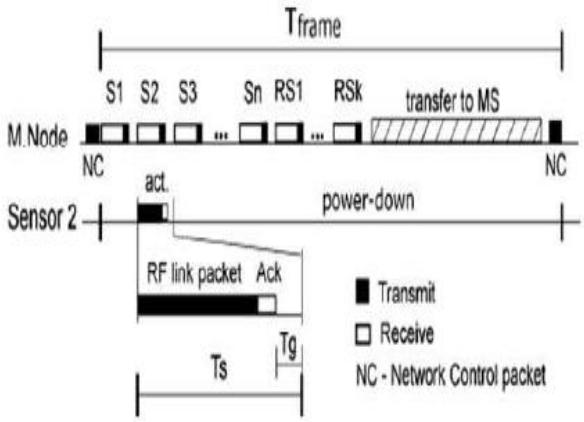


Fig.8. TDMA frame structure [7]

Extra time slot depend upon targeted packet error rate, packet drop and number of sensor nodes. Guard band time is inserted between two consecutive time slots to avoid collision/overlapping of packets transmission. Two types of MN can be used in this protocol one which is having single transceivers and the other one which is having two transceivers. The protocol consumes energy in case of communication data rates as well as for short burst of data. As, for periodic synchronization this protocol uses a Network Control (NC) packet after N number of time frames due to which extra energy is consumed [1]. It has fixed frame structure which is based on pure TDMA, and for on-demand traffic no CAP is provided to accommodate small burst of data.

Priority Guaranteed Mac Protocol

A super frame structure is used by this protocol. There are five parts of active period; a beacon, Control Channel AC1, Control Channel AC2, Time Slot Reserved for Bursty (TSRB) traffic, Time Slot Reserved for Periodic (TSRP) traffic [22].

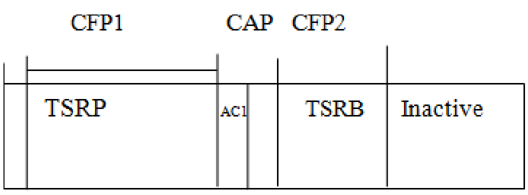


Fig.9. Super frame structure of priority guaranteed MAC protocol

Life-critical medical applications of uplink control are controlled by AC1 while Consumer Electronics (CE) applications of uplink control are controlled by AC2. For these two control channels Randomized ALOHA is used. Within two data channels TSRP and TSRB priority guaranteed protocol is based upon TDMA approach due to the assignment of Guaranteed Time Slots (GTS).Time slots are allocated on-demand to use control channel. This protocol results in better energy consumption. Major drawbacks of this protocol are inadaptability to emergency traffic and complex super frame structure [17].

Power Efficient Mac Protocol

For reliable transmission two wakeup mechanisms are defined: For normal traffic transmission traffic-based wakeup mechanism is used and for emergency/on-demand data transmission wakeup radio mechanism is used [16]. To monitor routine physiological parameters normal traffic is generated by the sensor nodes. To monitor emergency situation initiates unpredictable emergency traffic is initiated by on-body sensor nodes. Time axis of super frame structure is divided into three parts: a beacon message, to accommodate short burst of data Configurable Contention Access Period (CCAP) and a Contention Free Period (CFP) where Guaranteed Time Slots (GTS) are assigned to end nodes for collision free communication. Slotted ALOHA is used by the proposed protocol in CCAP.

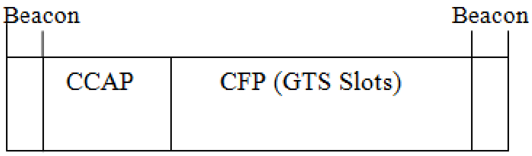


Fig. 10. Superframe structure of priority guaranteed MAC

Traffic-based wakeup table is organized by the coordinator according to application. Avoids Unnecessary energy dissipation due to idle listening and overhearing is avoided by periodic sleep/wakeup mode. For emergency traffic a wake up radio signal is send by the sensor nodes to coordinator other wake up signal for on demand traffic is send by the coordinator to sensor nodes [7].

Energy Efficient Medium Access Protocol

Energy efficient MAC protocol is designed to maximize energy efficiency using centrally controlled wakeup and sleep mechanisms. To reduce power dissipation due to overhead some upper layer functionalities are incorporated. This protocol is based upon star topology where on-body/implanted sensor nodes are coordinated by a central node (Slave nodes). This MAC protocol involves three processes. First is Link establishment; where a request to join the cluster is send by sensor node. A unique sleep time is assigned to each node to avoid idle listening and overhearing. Second is the wakeup service process, in which communication between slave and master mode takes place. Alarm process or Exception process is initiated by slave node for communication with master node to handle emergency data [16]. Wakeup Fallback Time (WFT) concept is introduced for guaranteed and reliable communication. If a failure occurs in assigned wakeup process, for a specific time interval sensor node enters into sleep mode. The time interval of sleep mode is calculated by WFT. In sleep time, data packets are buffered by sensor node for future communication. The same process is followed for master node if it fails to communicate with slave nodes. The centrally controlled process reduces efficiently due to idle listening and overhearing. To handle on-demand traffic this protocol has no proper mechanism as implementation of this protocol is complex [1]. Some drawbacks are: limited number of nodes in one cluster, communication can be initiated by mater node only and at a time only one node goes into link establishment process.

B-Mac

Berkely MAC uses adaptive duty cycling mechanism to reduce duty cycle and minimize idle listening and is an asynchronous MAC protocol. It employs an enhanced filtering method to enlarge the reliability of channel assessment. BMAC employs an adaptive preamble sampling scheme to achieve low power operation. Nodes periodically wake up for a short time interval in each duty cycle to check for preamble. For channel arbitration, link layer acknowledgments for reliability, and low power listening (LPL) B-MAC uses clear channel assessment (CCA) and packet back offs. To optimize throughput, power consumption, latency, fairness, reliability [18]

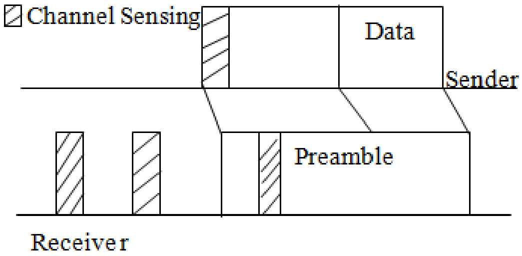


Fig.11. B-MAC frame structure

B-MAC makes local policy decisions. B-MAC provides bidirectional interfaces to chains on the- fly reconfiguration, for system services to optimize throughput, latency, performance, or power conservation. BMAC results in better packet delivery rates, throughput, latency, and energy consumption.

Med Mac

Medical Medium Access Control (Med MAC) protocol for WBANs is proposed to reduce energy dissipation and improve channel access mechanism. Med MAC uses TDMA approach for assignment of time slots for data communication to end nodes. The assigned time slots can be of variable length and may vary according to sensor nodes requirements. Multi-super frame structure is used by Med MAC, where for synchronization beacons are used. Optimal contention period is used for network initialization, emergency traffic, and low data communication.

Med MAC uses timestamp to maintain clock synchronization of nodes and coordinator scavenging with Adaptive Guard Band Algorithm (AGBA). For each sensor node collision of data packets is avoided using unique GTS.

To avoid collision due to clocks drift AGBA maintain synchronization of devices. Guard band time is inserted between two consecutive time slots using AGBA[7]. The guard band time is based on clock drift of devices and is adjustable. Guard band is supervised by Drift Adjustment Factor (DAF) to avoid waste of bandwidth using extra guard bands. GTS is used to avoid collision [18]. Med MAC takes low data traffic into significance which is not suited in WBANs where date rates for wearable and implanted sensors may be high.

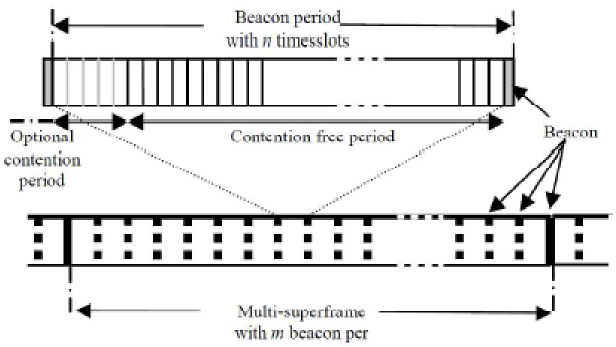


Fig.12. Multi super frame structure for Med MAC protocol [7]

H-Mac

H-MAC is heartbeat driven TDMA based MAC protocol. Traffic collision is one of the most important features of BSN's. The main task of the sensors is to collect all kind of psychological parameters. For ex: - When a person walks very fast or his temperature rises, the heartbeat rate blood pressure rate also roses with the rate of breathing. A single physiological fluctuation may wake up numerous radio sensors and incur a series of medium access request. H-MAC is a TDMA-based MAC protocol which is energy efficient and is designed for star-topology BSNs, in which an external network coordinator exists which is powerful. The coordinator could be a smart cell phone, a wrist worn pulse monitoring watch, or a PDA. Since the outer device can be re-energized easily, it could be served as gateway to other networks and may possess more computing resources. H-MAC assigns devoted time slots to each biosensor to assure collision-free transmission. By using the heartbeat rhythm which is inherited in human body HMAC takes the advantage. H-MAC attains time synchronization in TDMA without circulating periodic timing information, which lessens the energy cost. In H-MAC, synchronization information can be extracted from its biosensors, which are linked with or straightforwardly driven by the heartbeat pulsation [19].

Body Mac

A TDMA based MAC protocol where uplink and downlink sub frames are defined to ease sleep mode with emphasize on energy minimization. For low duty cycle sensor nodes sleep mode performs well. Using 3 bandwidth management procedures different data communication models are accommodated; Burst Bandwidth procedure, Periodic Bandwidth procedure and Adjust Bandwidth procedure. This management procedure which is having efficient and flexible bandwidth enhances network stability and transmission of control packets. MAC frame is divided into three parts; a beacon, a downlink and uplink. Beacon is used to achieve synchronization. Downlink is used for data communication from coordinator node to sensor nodes to accommodate on demand traffic.

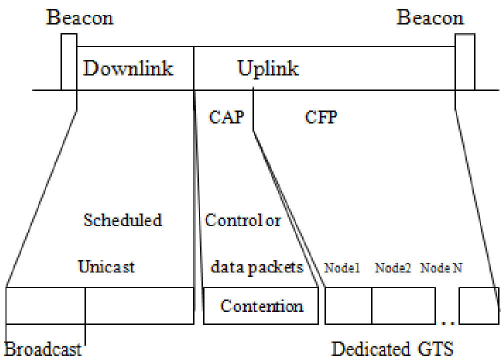


Fig.13. Body MAC frame structure

Contention Access Period (CAP) and Contention Free Period (CFP) are two parts of uplink frame. CAP uses CSMA/CA technique, where for sending packets to the coordinator for Guaranteed Time Slots (GTS) nodes have to compete with other nodes. However, during CAP nodes can also communicate for small data packets. In CFP coordinator assigns GTS to sensor nodes to avoid collision. For uplink frame in CAP, due to Clear Channel Assessment (CCA) and collision issues CSMA/CA ends up with high energy consumption [20].

Table 2: Summary of Existing MAC Protocols

Power Efficient Mechanisms	Protocols	Basic Operation	Advantages	Disadvantages
Schedule-Contention	SMAC	Reduce power consumption through periodic sleep listen	Energy waste caused by idle listening is reduced	Low throughput and loosely synchronised
	TMAC	Introduces adaptive duty cycle that can adapt to different traffic patterns	Increased throughput and end-to-end latency	Nodes go to sleep when neighbour still have data to send
	DMAC	Uses carrier sensing method to avoid collision	Adjust duty cycle according to sleep schedule	Loosely synchronised
	LMAC	Uses round robin technique to transmit the data.	Extends the network lifetime, decreases no. of transceiver switches	Overhearing
	ERMAC	Uses energy criticality function and allows more critical nodes to go sleep	No contention Mechanism is involved	Undergo overhearing while selecting critical node
TDMA	HMAC	Uses heartbeat rhythm to synchronise the clocks of nodes	Bandwidth efficiency is improved	Single point failure problem exists
	Body MAC	Uplink and downlink sub frames are introduced		
	Med MAC	Uses Multi-Super frame structure and beacons to synchronise the nodes.		
Low Power Listening	Wise MAC	Uses Preamble sampling technique to listen he idle medium	Adaptive to traffic load, Low Power consumption	Limit throughput
	BMAC	Asynchronous Mac protocol uses adaptive duty cycling to reduce duty cycle	Improved latency, high throughput, flexible	

Wise-Mac

Wise MAC is a medium access control protocol designed for wireless sensor networks. This uses the preamble sampling technique to minimize the power consumed when listening to an idle medium and is based on non-persistent CSMA. The uniqueness in this protocol consists in developing the knowledge of the one's direct neighbors sampling schedule to use a wake-up preamble of minimized size. No set-up signaling and network-wide synchronization is required; it is adaptive to the traffic load. In low traffic conditions provides ultralow power consumption. Sampling of the medium is done by the sensor nodes with constant period. Relative sampling schedule offsets of nodes are independent. When the medium is busy, sensor node waits for the medium to become idle by continuously sensing the signal. A wake-up preamble equal to the size of the sampling period is added in front of every data frame at the transmitter side to make certain that the Receiver will be awake when the data portion of the packet arrives. When the channel is idle WISE MAC consumes less energy. WISE MAC has long wakeup preambles which limit throughput and consumes large power [21].

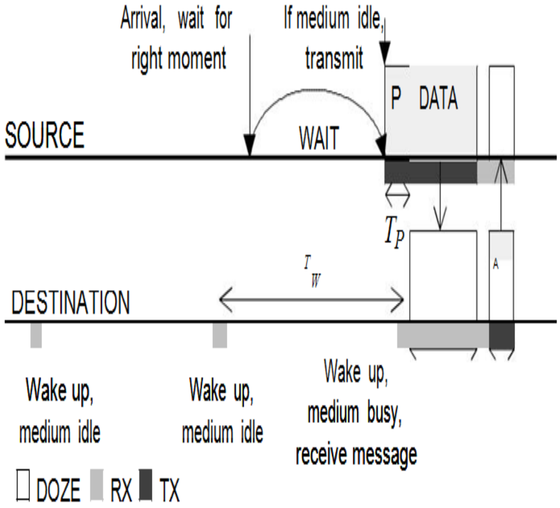


Fig.14. WISE MAC [21]

VII. Conclusion

Various existing MAC protocols for WBANS have been analyzed with the main focus on energy consumption. Various advantages and disadvantages of these protocols have been discussed. Due to different hardware constraints and application requirements, no one protocol is being accepted as a standard. To achieve requirements of WBANs like energy efficiency, scalability, fairness reduced implementation complexity, support for divers applications interoperability reduced synchronization overhead and quality of service anew protocol need to be developed.

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