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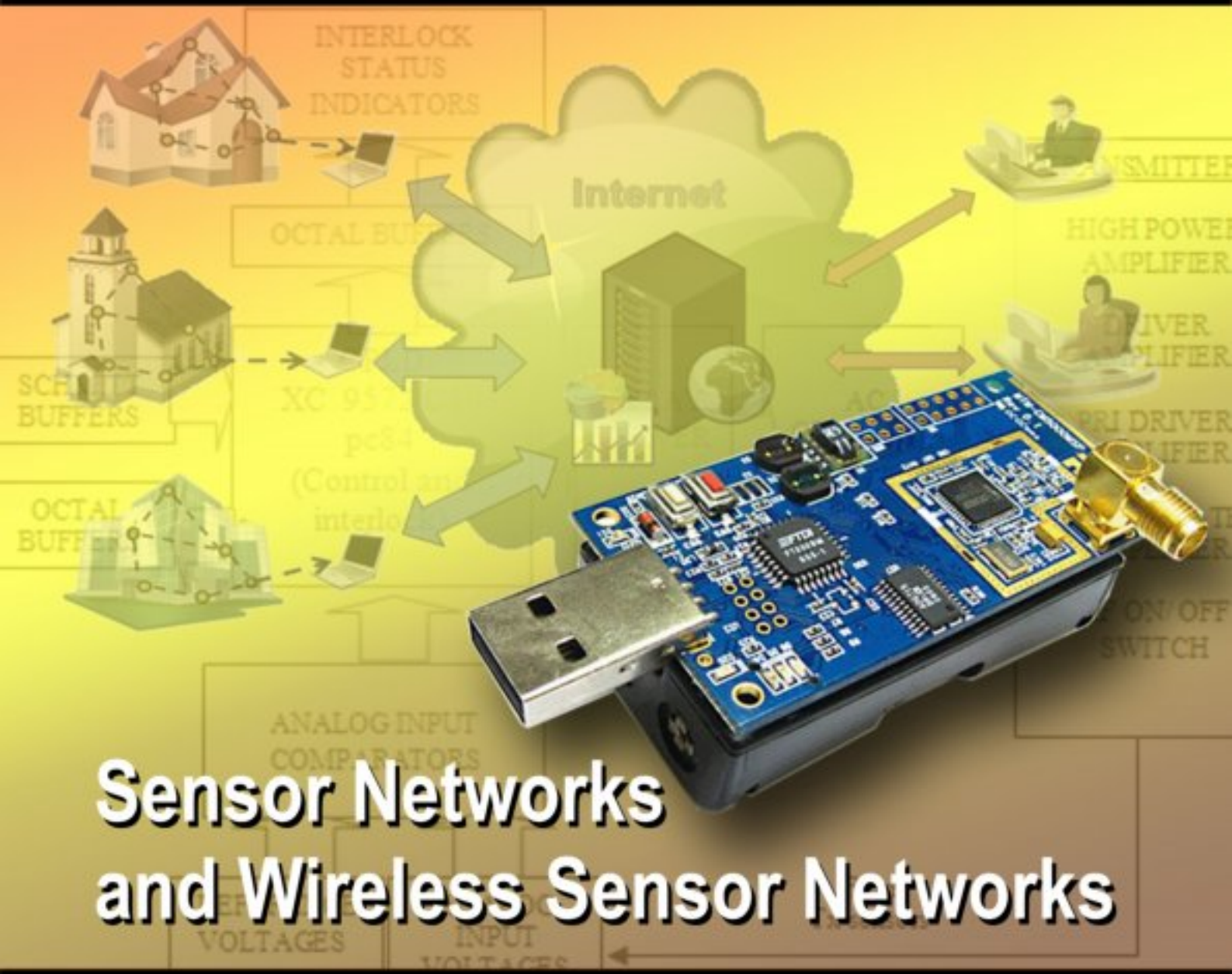

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Survey is based on Synchronized and Asynchronized Approach of MAC Protocols in WSN

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Abstract: A wireless network is made of spatially distributed autonomous devices. These devices are called sensors. The sensor is used for monitoring physical or environmental conditions. The potential application of wireless sensor network is environmental monitoring, healthcare applications and tactical systems. In this paper focus is on the MAC protocol for WSN. Wireless sensor network is deployed for wide range to send and receive data with the help of medium. Here literature survey of MAC protocol based on the synchronized and asynchronized approach is described which is used to meet different objective like access a medium, statistical channel allocation, spectrum utilization. *Copyright © 2010 IFSA.*

Keywords: MAC protocol, WSN, Channel utilization, Control packet overhead.

1. Introduction

MAC layer is divided in to several layers for network communication. [1-5]. Two sensor nodes are interfering with each other's with the help of Medium Access Control (MAC) layer [6]. Each network node deals transmissions according to the situation. The MAC protocol design for minimizing energy consumption and minimize latency. A sensor node has a battery-operated and radio .The radio on a sensor node is wireless transmission media. The radios used in transceivers. It is consumed power in transmitting a packet. Here focus is on sensor a network property which is used for different objectives in MAC layer protocols.

2. Related Work

The use of MAC layer has been extensively studied in literature to maximize packet throughput and minimize latency. There are many solutions the problem of energy waste due to idle listening. There are several MAC protocol divided in to two categories as synchronized and Asynchronized. A synchronized MAC protocol is SMAC [2], TMAC [3] and DMAC [11] fall into this category. And Asynchronized MAC protocol is BMAC [12], XMAC [13] and CMAC [14].

S-MAC [2], based on a low power RTC-CTS, it is used for loose synchronization between nodes that allow low power duty cycling. The protocol uses three techniques: periodic sleep, virtual clustering, and adaptive listening. In the wireless sensor network the sensor node is periodically wake up, receive and transmit data. In the awake period the nodes transmit packets using RTS-CTS and synchronization information is exchanged. After the, awake period the nodes enter sleep mode. A node exchanges synchronization and schedule information between immediate nodes, so that transmission will reduce latency as forward the packet in immediate nodes.

T-MAC [4] is used for shortening the awake period when the channel is idle. It improves the design of S-MAC. In there synchronization phase the node is listening to the channel only a short time. If there no data is received during this window then the node returns to sleep mode. So that duty cycling reduces energy and increased latency.

B-MAC [12] is based on CSMA technique. It is utilizes low power listening and an extended preamble to achieve low power communication. All nodes have an independent schedule awake and a sleep period; each node can have an independent schedule. So that the sleep schedule to adapt changing traffic loads. If a node wishes to transmit data packet, it have a preamble, which is slightly longer than the sleep period of the receiver. A sender is detect the preamble receiver will wake up to receive the data.

Wise MAC [3], it achieves low power communications with the help of preamble sampling. It solves many of the problems associated with low power communications.

Sift [9] is based on event-driven sensor network environments. The motivation behind Sift is that when an event is sensed. Sift is a method for contention slot assignment algorithm.

3. MAC Layer Attributes in WSN

To design a good MAC protocol for the wireless sensor networks, the following attributes must be considered [2].

1. Collision avoidance: - A wireless sensor network two node send data at same time in same range then the collision is occur. Collision avoidance is the process of preventing collision free network.

2. Causes of energy waste :-The first reason of energy waste is A node receives more than one packet at the same time, packets that cause the *collision* have to be discarded these packets are called “collided packets”. The re-transmissions of these packets are required increase the energy consumption. The second reason of energy waste is *overhearing* unnecessary traffic, meaning that a node receives packets that are destined to other nodes. The third energy waste occurs as a result of *control packet overhead*. Minimal number of control packets should be used to make a data transmission. The forth energy waste sources of energy waste is long *idle listening*, i.e., listening to an idle channel to receive possible traffic. Idle listening consumes 50—100 % of the power for receiving.

The last reason for energy waste is *over emitting*, which is caused by the transmission of a message when the destination node is not ready.

3. Channel utilization: - The channel utilization is also called as bandwidth utilization efficiency. The bandwidth utilization in terms of throughput. The throughput is defined as the total number of packets delivered at the receiver node per time.

4. Latency:-.Latency is defined as how much time to require to send the data one node to destination node. If the event is generated and immediately reported to the sink node in real time.

4. Categories of a Well-Defined MAC Protocol

MAC protocol is dividing in to two categories (Table 1):
A) Synchronized
B) Asynchronized

In synchronized approaches requires periodic synchronization. The exchange message consumes significant energy [2]. Protocols using this mechanism require nodes to periodically synchronize wake-up schedules with their neighbors using explicit messages. The nodes wake up and sleep according to the synchronized schedules. SMAC [2], TMAC [4] and DMAC [11] fall into this category.

In Asynchronized approaches requires not synchronize nodes until there is traffic.

Table 1. Categories of MAC Protocol.

	MAC PROTOCOL
Synchronized	S-MAC/T-MAC Wise MAC TRAMA, SIFT D-MAC
Asynchronized	B-MAC X-MAC C-MAC DPS-MAC

5. Proposed MAC Layer Protocol

5.1. S-MAC

The basic idea behind the Sensor-MAC (S-MAC) protocol is locally managed synchronizations and periodic sleep listen schedules based on synchronizations [2]. Schedule exchanges are periodical SYNC packet broadcasts to immediate neighbors. The period SYNC packet is called the synchronization period. Neighboring nodes reside in two different form virtual clusters to set up a common sleep schedule and wake up at listen periods. In there the immediate nodes have their own sleep schedules. The periodic sleep may result in high latency for multi-hop routing algorithms. The latency caused by periodic sleeping is called sleep delay [2]. Collision avoidance is achieved by a carrier sense, RTS/CTS packet exchanges are used for unicast type data packets.

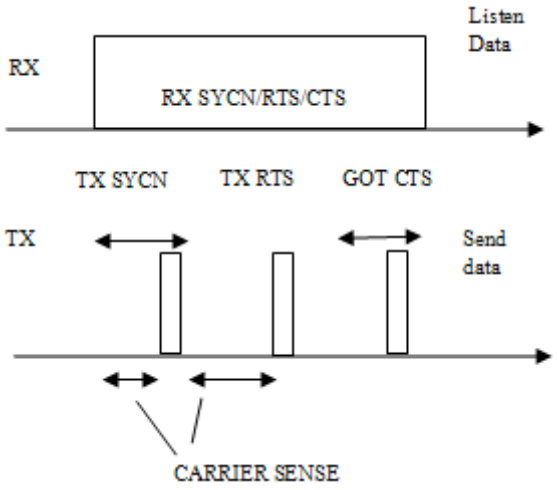

Fig. 1. S-MAC Messaging.

Drawback- The proposed SMAC algorithm has two different results for more energy consumption via idle listening and overhearing. Sleep and listen periods are predefined and constant, which decreases the efficiency of the algorithm under variable traffic load.

5.2. Wise MAC

The basic idea behind the Wise MAC protocol is Spatial TDMA and CSMA with Preamble Sampling protocol [3]. All sensor nodes are having two communication channels, data channel is accessed with TDMA method and the control channel is accessed with CSMA method. This protocol is used non-persistent CSMA (np-CSMA) with preamble sampling as in [3] to decrease idle listening. In preamble sampling precedes each data packet for alerting the receiving node. A network node finds the medium busy after it wakes up and samples the medium. The node is continues to listen until it receives a data packet or the medium becomes idle again. If receiver node may not be ready at the end of the preamble, due to causes the possibility of overemitting type energy waste. The overemitting is increased with the length of the preamble and the data packet, therefore no handshake is done with the intended receiver. Wise MAC offers an algorithm which is dynamically determining the length of the preamble. In this method uses the knowledge of the sleep schedules of the transmitter neighbor's nodes. This neighbor's nodes learn and refresh sleep schedule during every data exchange and the acknowledgement message. There very node keeps a table of sleep schedules of its neighbors, the schedules transmissions having the destination node's sampling time corresponds to the middle of the sender's preamble. It decreases collisions caused by that specific start time of wake-up preamble and random wake-up preamble. Another parameter clock drift between the source and the destination affecting the choice of the wake-up preamble length.

Drawback- Wise MAC is that decentralized sleep-listen scheduling problem for broadcast type of communication different sleep and wake-up times for each neighboring node. The broadcasted packet will be buffered when neighbors in sleep mode and delivered many times as each neighbor's wakes up mode. However, results will redundant transmission as higher latency and power consumption. There another problem is hidden terminal problem, one node starts to transmit the preamble to neighbor a node that is already receiving another node's transmission will result in collisions. That is because Wise MAC is also based on non-persistent CSMA.

5.3. Traffic-Adaptive MAC Protocol (TRAMA)

TRAMA [7] is a TDMA-based algorithm utilization of classical TDMA in an energy efficient manner. It is similar to Node Activation Multiple Access (NAMA) [8], there each time slot a distributed election algorithm is used to select one transmitter within two-hop neighborhood. This election eliminates the hidden terminal problem that ensures neighbor's nodes in the one-hop transmitter will receive data without any collision. In this proposed algorithm time is divided into random-access and scheduled-access (transmission) periods. There used Random-access period is establish two-hop topology information which is based on contention-based channel. The information passed by the application layer, MAC layer. The transmission duration can calculate at time t, the node is highest priority among two-hop neighbors calculates the number of slots period [t, t+ SCHEDULE_INTERVAL]. The node announces the highest priority slot is used intended receivers for these slots with a schedule packet. The slots for which it has the highest priority but will not be used. The schedule packet using a bitmap whose length is equal to the number of its neighbors. The bitmap is ordered by their identities. The intended receiver node messages have the exact list and identities of the one hop. The vacant slots are announced, evaluated for re-use of those slots. Priority of a node on a slot is calculated with a hash function of node's and slot's identities.

Drawback- There every node time slot calculates each of its two-hop neighbors' priorities. Transmission slots are set to be seven times longer than the random access period [7], the duty cycle is at least 12.5 %, which is a considerably high value.

5.4. SIFT

SIFT the basic idea behind the Sift [9] protocol proposed for event-driven sensor network. In the Sift protocol when an event is sensed, the first potential reports have been generated [9]. Therefore the message to be relayed with low latency. There some assumption a slot is non-uniform probability distribution function within the slotted contention window. The first slot of window no node starts to transmit. Each node increases its transmission probability exponentially. Energy consumption traded off as indicated below .So that very low latency is achieved with many traffic sources. Sift protocol is based on contention slot assignment algorithm, it is based on same idea like SMAC. Sift has a distribution approximate to CSMA/p*[10]. Where p* is a non-uniform probability distribution that optimally minimizes latency.

Drawbacks- It is increased idle listening because when it sends all slot needed as listening. It is increased overhearing. There is an ongoing transmission. All nodes must listen at the end in order to contend for the next transmission. The complexity of system is increases as time synchronization for slotted contention windows.

5.5. DMAC

In the DMAC protocol is based on Slotted Aloha Algorithm, here all nodes are assigned a slot. All node communication patterns are convergecast. The node communication path is unidirectional. It represented as data gathering trees. The main aim of DMAC [11] is to achieve very low latency. A data gathering tree source connects to the sink with a unidirectional path. When a receive period of a node at this time all of its child nodes has transmit periods. It is achieves good latency compare to sleep/listen period assignment methods.

Drawback- Collision is occurring when same level of node try to send data at the same schedule. There is violation of Collision avoidance methods.

5.6. BMAC

BMAC [12] protocol is used in unsynchronized environment. There used unsynchronized duty cycling and long preambles. Sender uses a long preamble to send the data packet. The sender sends each packet after wake up the receiver. The data is transmitting as RTS/CTS strategy. It is minimizing the listing cost [12]. This technique is based on Sleep/Wake scheduling which is using Low Power Listening (LPL). This is similar as preamble sampling in aloha. But its having different radio characteristics. It check every wake up Interval until it find a channel start sending and receiving packet otherwise it go back to sleep in Check-Interval.

Drawback- The long preamble mechanism has many problems as energy consumed on preamble transmission because of the receiver has woken up is wasted. The other problem is overhearing because of long preamble neighbors nodes and intended receiver will awake until the data packet transmission finishes.

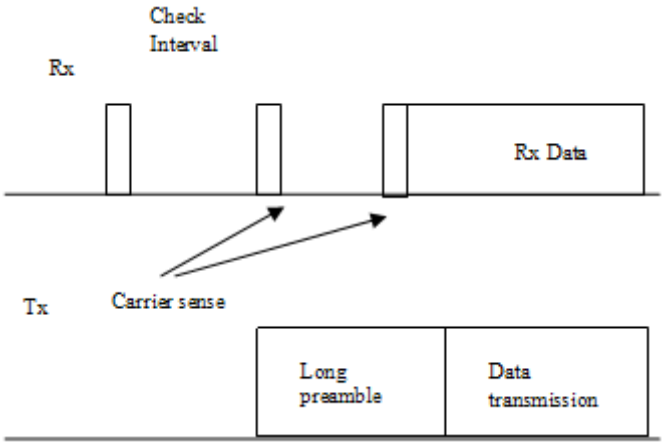

Fig. 2. BMAC Messaging Scenario.

5.7. CMAC [14]

Aggressive RTS, anycast, and convergent packet are the mostly observed communication pattern within sensor networks. In the CMAC protocol is accessed with double channel. It is based on long preamble. These long preambles break into multiple RTS packets. The RTS packets separated by fixed short gaps. This gap is receivers to send back CTS packets. When CTS packet receives transmitter then it sends back the data packet. The number of RTS packets depends on the duty cycle length. The collision avoidance mechanics is fellow by carrier sensing channel. There anycast is based on to quickly discover forwarder. These per hop latency could be reduced because of same RTS. CTS transmissions are prioritized to overcome the anycast overhead. However, the overhearing nodes cancel their CTS transmissions. The gap between two consecutive RTS packets is divided into 3 sub-intervals called CTS slots. These CTS slot is divided into *minislots*. The node is near to the destination node it send CTS packet to closer CTS slot. In the convergent packet forwarding to reduce the anycast overhead. The advantages of CMAC is reduced the traffic with the help of "double-check" mechanism. Drawback- It consumes lot of energy in the longer awake period.

5.8. XMAC [13]

The XMAC is based on low power listening, also called preamble sampling. It is suboptimal the problem which is generated in BMAC. The problem as energy consumption excess at non-target receivers and reduce latency. XMAC sends short strobes to the target receiver encoded with target id. If in the intermediate node are non target receiver node then it is go back to sleep. The data is only goes to the target receiver. The target receiver node is wake up then it receiving data packet. So that less energy is consuming. The overhearing problem is reducing as use a strobe preamble. It is allow that the target receiver wake up and interrupt the long preamble. This algorithm is adjusting the duty cycle of receivers and overcome the traffic load.

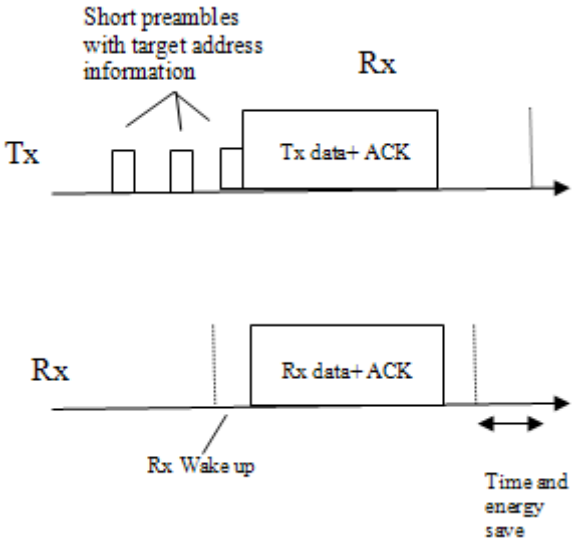

Fig. 3. X-MAC Messaging Scenario.

6. Comparison of MAC Protocols

Table 2 represents a comparison of MAC protocols investigated. The synchronized MAC protocol column indicates whether the protocol is synchronized MAC Protocol or not. The Access schemes column indicates the allocation of channel is random and slotted. Time Synchronization Needed column indicates whether the protocol ability to handle which topology. The access schemes have the same features with SMAC, T-MAC Wise MAC, TRAMA , SIFT and DMAC.

7. Conclusion

In this paper is focus on the different proposed MAC layer techniques. This proposed protocol is used in different wireless sensor network. The use of MAC layer has been extensively studied in literature. MAC protocols are designed to maximize packet throughput, achieves low power communications, minimize energy consumption, minimize latency and provide fairness protocols. Then describe several MAC protocols for sensor networks these protocol technique is SMAC [2], TMAC [4], Wise MAC [3], TRAMA [7], SIFT [9], DMAC [11], BMAC [12], XMAC [13] and CMAC [14].

Table 2. Comparison of MAC Protocols.

	Access schemes	**Synchronize MAC**	**Type**	**Time Synchronization needed**
SMAC	Slotted	Yes	CSMA	No
Wise MAC	Slotted	Yes	np CSMA	No
TRAMA	Slotted	Yes	CSMA/ TDMA	Yes
SIFT	Slotted	Yes	CSMA/ CA	No
DMAC	Slotted	Yes	TDMA/ Slotted aloha	Yes
BMAC	random	No	CSMA	No
XMAC	random	No	CSMA	No
CMAC	random	No	Slotted aloha	Yes

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Guide for Contributors

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- Theory, principles, effects, design, standardization and modeling;
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- Nanosensors;
- Microsystems;
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