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A SURVEY ON MAC PROTOCOL IN UNDERWATER SENSOR NETWORK

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ABSTRACT

Aim: *Underwater sensor network is widely used in many applications such like, environment monitoring, mobile object tracking, navigation applications, etc. In UWSN, MAC protocol plays an important role. Here radio waves are used for communication. We also use the acoustic communication, mainly used in physical layer with longer range but high error probability and node mobility are limited. MAC protocol contains two main nodes they are sensor node and sink node. Sensor nodes are deployed into a connected network to gather sensor data and send the data to the sink node. In this survey paper, we compare the throughput, collision rate, advantage, disadvantage and methodology of each MAC protocol and we also compare the issues and steps to overcome UWSN.*

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KEY WORDS

MAC protocols, underwater sensor network, wireless sensor network

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INTRODUCTION

Wireless sensor network is used in wide range. Specifically, in this paper we use WSN in the process of underwater sensor network and its applications. In UWSN it contains many sensor nodes mainly used to collect information and processing the data. These are managed by the sensor node. The sensor node is capable of collecting data from one or more sink nodes. These nodes are mainly used to reduce the power consumption. Here we use MAC protocol as the backbone of the operations. There are many sets of MAC protocol being used in UWSN and in WSN. Some of the MAC protocol are QMAC, Asym-MAC, Z-MAC, etc. Each of the MAC protocol contains different algorithms or steps followed and vary in each set of function and in execution.

In underwater sensor network the detector node which is mainly used for collecting the information through the wireless sensor network. It mainly operates in power unit and its impossible to replace that unit. Detectors are mainly used for minimizing the memory and bandwidth and to increase the range of communication. The main scope of the detectors is to handle the critical section. It also contains another detector called the spatially distributed autonomous used for monitoring the functions. This UWSN is mainly build by nodes which is used to pass the data, monitor the function, intimation of intruder's etc.

MAC protocol plays an important role in UWSN. MAC is also called as medium access control. It acts as medium when a data transaction undertaken. This protocol layer is a communication network protocol and as a sub layer. This layers is also under the layer of OSI. It's the second layer data layer or data link layer. Here we take the IEEE, this is divided into two sectional part they are LLC and MAC. LLC stands for logical link layer and MAC stands for medium access control. This LLC is under IEEE and it contains three sub protocol. IP protocol, IPX protocol these are mainly used to carry the packet or at the period of transmission. Similarly the MAC layer contains two main functions they are data encapsulation and frame initiating

This MAC layer contains more set of protocol such like ALOHA, CSMA, CSMA/CD, CSMA/CA etc. Here we take the ALOHA, this is mainly used in terrestrial broadcasting function and implementations in the satellite system. It has the power to hander more channel. Collisions are expected to occur because the function of this protocol is when the node is ready to send data it transmits and collision occurs. The CSMA protocol is used in

shred topologies. It is used to capture the data before sending a data and if a node s busy to capture the data then it waits. Hence to overcome the waiting process of the node we intake two sections they are CSMA/CD, CSMA/CA.

MAC PROTOCOL OF WSN

There are more set of MAC protocol used in underwater sensor network. We compare the collision, energy efficient, and their major issues in these compared papers.

Chih-Min [1]major in wireless sensor network and it intake the QMAC for function. This MAC is also called as Quarum MAC. It is used in several application such like environment monitoring and navigation application. QMAC saves the energy and reduce collision. In this the major concept is next hop condition. Using this concept the latency is being reduced. The lifetime of the sensor node are based on the energy efficient protocol. (QMAC) protocol that enables sensor nodes to sleep longer under. To conserve energy, MAC protocol, realizing that sensor nodes have different loads due to their different distances to the sink. To adjust their sleep durations based on their traffic loads the concept of quorum is used. To reduce delays induced by longer sleep durations, we have increased each node's transmission opportunity by enabling group of next-hop nodes to accomplish the packet-relaying job. light loads to reduce transmission latency. The major pros and cons of this paper is QMAC protocol that enables sensor nodes to sleep longer under light loads. QMAC protocol saves more energy and keeps the transmission latency low. To reduce transmission latency. CONS are regular sleep/awake mechanism fails to adjust a sensor node's sleep duration based on its traffic load, thus causing either lower power efficiency or higher latency. Furthermore, sensors may be deployed in hostile environments and may thus unexpectedly fail. Most power-saving protocols do not promptly react to such link breakage, resulting in long transmission delays.

Myounggyu Won [2] he presents the Asym MAC, these are used for several application such like medical and military field. Here the collision occurs at the sender and the energy is consumed. The major issues in this paper is low channel utilization and they are overcome using the concept receiver imitated protocol. This concept provide a performance called combat performance degradation. The lifetime of the sensor node is based on LB-MAC.

Chih-Min Chao [3] he present the MM protocol which states multiple-rendezvous multichannel MAC protocol, undertaken underwater sensor network. The lifetime of the sensor network is based on the distributed multiple rendezvous multichannel MAC protocol and they also provide the channel allocation and overcome the problem of receiver. It reduce the collision and consumes the energy using this concept. This protocol is used in many application some of them are disasters warning and tactical surveillance.

Pei Huang [4] uses the RC-MAC major in wireless sensor network.. It has certain issues like over hearing problem and they use the concept of receiver centric scheduling to overcome this issues. They provide high throughput and reduce the collision rate. The application used in this protocol are target tracking and intrusion detection.

Tiansi Hu [5] major in underwater sensor network. In this paper they use the DSH MAC protocol mainly used for past decade application. The use the concept of decoupled and suppressed handshaking which provide the channel allocation and throughput. It reduces the collision using this concept and the lifetime of the sensor node is based on RTS and CTS MAC protocol. RTS states Request to Send, this is used to send the request when a node is ready to data to another sensor node. At that time this RTS works. CTS states that Clear to Send, when the request RTS is send from one set of node and check the availability. If the nodes are free to transmit the data then it send the acknowledgment called CTS.

Chao Li [6] this paper represents the DTMAC which is mainly used for sparese network and maily use the novel delay tolerant MAC. using this MAC protocol it overcome the long propagation delay and swarm mobility. The energy efficiency is consuming less and it avoid the collision. The lifetime of the sensor node is based on the coupon collection algorithm and RTS/CTS protocol.

Chih-Min Chao [7] Multiple-Rendezvous Multichannel MAC Protocol Design for Underwater Sensor Networks distributed multiple-rendezvous multichannel MAC protocol, MM-MAC is a multiple rendezvous protocol; only one modem is required for each node. Utilizing cyclic quorum systems, nodes running MMMAC are guaranteed to meet their intended receivers, which solves the missing receiver problem. The separation of control and data transmissions also helps reduce the collision probability of data packets. MM-MAC, to reduce collision probability. The major advantage of this paper is Only one modem is needed for each node to solve the missing

receive problem multiple sensor node pairs can complete their channel negotiations on different channels simultaneously. Data packets will not be collided by control packets. The disadvantage is Fail to function effectively in a multi hop network consisting of more sensor nodes with heavier traffic loads. In underwater sensor networks (UWSNs) include Lower transmission rate, longer delay time, and higher power consumption.

Maaz M. Mohiuddin, [8] this paper represent the concept of clock driven and event driven. Here the clock driven is based on periodic scheduling and they mainly used under internal clock function. The data packets also execute in periodic function. Then we take event driven, these are based on the external agent. The major issues are timely delivery of packets. These issues are overcome by the using the EEDF MAC. There are several application used under this MAC protocol they are environmental parameters. The lifetime of the sensor node is based in the cluster size and energy efficient. In this paper there are five phases they are network initialization phase, schedule broadcasting phase, data transmission phase, synchronization phase and control phase. The first phase is taken over at the first time of the set up and event driven transmit the data from one to another using the CSMA/CA . Here now second phase start working , it has the combination of the event driven and the clock driven are taken and they are schedule the sink node data collected by the sensor node. They form these result as a table and transmit to the third phase. The third phase is the data transmission phase and they transmit the data which is having the high priority and transmit the low priority data in later. Then fourth phase is synchronization phase here they has the topology network and they collect the data of the failure nodes and consolidate the data to one document and transmit them. Here they create a new set of document using the old and failure data.

Lei Tang[9] et al present the paper in EM MAC , also called as energy efficient MAC protocol. These are suitable for wireless sensor network. Their major issue is they doesn't relay on the dedicated control channel and hence we use the reduce duty cycle function which provide the multichannel redezeous. They reduce the collision rate and application used under this MAC protocol is zigbee channel. The lifetime of the sensor node is based on the O-MAC. This O-MAC contains wake up time section for receiver and generate the slot number with frames. They are based on the Pseudo-random Staggered on scheme

Geethanjali and pravin [10] describe the protocol for energy and its efficiency for this we include the multi-channel MAC. The main mechanishm of this paper is multichannel. They avoid collision and consume the energy. The major issues are distributed channel assignment and efficient cross channel communication. This MAC protocol overcome this issues using the multiple channel and sleep allocation. There are many application used under this MAC function some of them are industrial control, monitoring, security and military intelligence. The lifetime of the sensor node is based on the MAMAC, this utilize the quorum system and also deal with the mutual exclusion problem.

Here we have taken MAC protocol which plays major role in Wireless sensor network and underwater sensor network. Each of the MAC protocol avoids the collision and reduces the collision using the concept of the different set of MAC protocol

LIFETIME OF MAC IN WSN

Here we combine all set of MAC protocol papers based on wireless and underwater sensor network each of the sensor nodes increases their lifetime by certain MAC. each paper takes different algorithm , different MAC protocol , different function for improving the strength of the sensor nodes.

Lifetime of the sensor node should be improved and using this latency then power will be consumed in low rate. We can achieve the long battery life. Chih-Min [1] et al represent the paper under QMAC, the lifetime of this MAC is improved by using the energy efficient protocol. This protocol overcome the problem like idle listening and conserves energy. They are maintained by this MAC function using QMAC_LR it increase the power by saving and it overcome the problem depletion.

Tiansi Hu [5] this paper's sensor node lifetime is based on the RTS/CTS MAC protocol. This protocol is mainly used for the handshaking process, in this they reserve the channel of communication. When the sender is ready to send the data then it request for the near by neighbour nod by RTS function. These nearby node check for the availability, if any data is working under this node then it avoid this RTS request to overcome the collision. These process are mainly taken over by the two control periods they are NOTE and GRANT. The NOTE packet is used to inform the number of buffered packet and it also intimates the transmission intension of the sender. Similarly

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the GRANT packet is used to inform the readiness of the data. these control packet is based on decoupling and data transmission /handshaking process. This is the interior process of RTS/CTS function. Using this the lifetime of the sensor node is increased.

Table -1

S.NO	MAC LAYERS	MAJOR IN	COLLISION	ENERGYEFFICIENCY	LIFETIME	ISSUES	APPLICATION	PROVIDE	CONCEPT
1	QMAC	WSN	Expected	Save	Energy Efficient Protocol	Node Delay Pending Packet	environment monitoring, navigation application	reduces latency	Next Hop
2	Asym-MAC	WSN	At Sender	Consume	LB-MAC	Low channel utilization	Medical,military	combat performance degradation	Receiver Initiated Protocol
3	MM-MAC	UWSN	Reduces	Consume	distributed multiple-rendezvous multichannel MAC	channel assignment & transmission scheduling	tactical surveillance, disaster warning	channel allocation & to solve the missing receiver problem	Cyclic Quarum System
4	RC-MAC	WSN	Reduces	Improve	novel receiver-centric MAC protocol	overhearing problem	Intrusion detection, Target tracking	High Thorughput	receiver-centric scheduling
5	DSH-MAC	UW-ASN	Reduce	More	RTS/CTS MAC protocol	Long Probagation	Past decade	Channel utilization & throughput	Decoupled & supressed handshanking
6	DTMAC	UW-WSN	Avoid	Consume less	coupon collection algorithm & RTS/CTS protocol	Swarm mobility,long probagation delay	Sparese n/w	Optimmal throught put	Novel delay tolerant MAC
7	ZMAC	WSN	Reduces	Good	B-MAC	slot assignment failures & time-varying channel conditions	Real Time	high channel utilization and low-latency	time slot assignment algorithm.
8	EEDF-MAC	WSN	Avoid	Save	cluster size and energy efficient	timely delivery of packets	environmental parameters	energy efficiency & improved latency performance	clock-driven and event-driven
9	EM-MAC	WSN	Reduces	High	O-MAC	Doesn't rely on dedicated Control channel	ZigBee channel	multichannel rendezvous	Reduce Duty Cycle
10	Multi channel MAC	WSN	Avoid	Consume	MAMAC	Distributed channel assignment & efficient cross channel Communication	Industrial control and monitoring, Security and military intelligence	multiple channels & sleeping mechanism	Multichannel
11	RPMAC	WSN	Avoid	Improve	novel receiver-pivotal MAC	Adapt to Low Duty Cycle	surveillance, intrusion detection and target tracking	integrates duty cycling and receiver centric scheduling	Multichannel
12	MC-LMAC	WSN	Avoid	Save		Scheduled access	intruder detection , structural health monitoring	higher throughput	single channel LMAC protocol
13	Multihop Fair Access-MAC	WSN & UWSN	Reduce	Reduce	TDMA scheduling algorithms	propagation delay	moored oceanographic	composite throughput	single-channel and half-duplex radios & grid networks
14	X-MAC	WSN	mitigate	Save	awake state and a sleep	long sleep time	traffic loads	energy consumption,	asynchronous duty-cycled

					state			latency, and throughput	MAC
15	BiC-MAC	UW-AN	depends on the distribution	Save	time-slotting	channel utilization	terrestrial-based models	novel analytical framework	bidirectional concurrent data transmissions

COMPARISION OF MAC PROTOCOLS

Shuguo Zhuo[16] et al is the process of I Queue MAC. In this they balance the traffic load by adaptive duty cycle and increase the through put and energy efficient. There are five key features they are without any overhead the load information will be accurate , allocation of TDMA here the node takes the data from the sender and exchange the simple node to the time slots using this the throughput is increased. Synchronization of the nodes which are of neighbouring nodes using LPL condition, shortening the channel from a router to another router transmission and finally multi-channel gains the acknowledgement. The lifetime of the sensor node is based on the sleep and active

CONCLUSION

In this paper we have taken a comparative study about the MAC protocols major in underwater sensor network, wireless sensor network and acoustic sensor network. In this, there are many different MAC protocol with different mechanism and different algorithm and different function. Here we compare the efficiency, throughput and collision rate. Using this comparison we improve the old scheme with new concept. This new concept improve the functionalities, throughput rate and avoid collision. It also reduce issues taken over in old scheme. In each mechanism there will be new challenges that cannot be avoided, and some can be avoided with new concept. **[Table-1**] describe about the MAC protocol and their performance. Using this we can improve the functionalities in better way.

[Table-1] defines the different protocols the first paper Chih-Min Chao [1] et al, he represent the major issues in the paper is node delay pending packet. This issue is rectified using the MAC protocol called QMAC. QMAC is quorum and provide a next hop concept, this concept is used to avoid the issue node delay pending rate because the next hop which used to have cyclic quorum in the time slot so its harder to leave a data without any functionalities.

Tiansi Hu [5] he represents the issue long propagation. This drawback is rectified by DSH-MAC ie. Decoupled and supressed handshaking process. Its followed by RTS/CTS MAC protocol (request to send / clear to send). Here two sets of mode are taken sleep and awake. The nodes will be awake when a data is ready to transmit and reaming time the node will go to sleep mode. When the node is in sleep mode then it can't transmit any set of data so, at this part of section the node send RTS is send to the neighbour by data. Then the node awake for the time of transmitting and after that it move on to the sleep mode.

Here we compared two papers in theory and such like there are more set of papers. The large scale of localization system which affects the speed, communication cost, coverage and improve the performance of MAC protocol.

CONFLICT OF INTEREST
The authors declare no conflict of interests.

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REFERENCES

[1] Chih-Min C, Yi-Wei L. [2010] A Quorum-Based Energy-Saving MAC Protocol Design for Wireless Sensor Networks" IEEE transactions on vehicular technology. 59(2).

[2] Myounggyu W, Taejoon P, Sang H. [2014] Son Asym-MAC: A MAC Protocol for Low-Power Duty Cycled Wireless Sensor Networks with Asymmetric Links, IEEE communications letters. 18(5).

[3] Chih-Min C, Yao-Zong W, Ming-Wei L. [2013] Multiple-Rendezvous Multichannel MAC Protocol Design for Underwater Sensor Networks, IEEE transactions on systems, man, and cybernetics: systems. 43(1).
[4] Pei H, Chen W, Li X. [2015] RC-MAC: A Receiver-Centric MAC Protocol for Event-Driven Wireless Sensor Networks, IEEE transactions on computers. 64(4).
[5] Tiansi H, Yunsi F. [2013] DSH-MAC: Medium Access Control Based on Decoupled and Suppressed Handshaking for Long-delay Underwater Acoustic Sensor Networks, IEEE conference on local computer networks.
[6] Chao Li, YongJun Xu, ChaoNong Xu, ZhuLin An, BoYu Diao, and XiaoWei Li. [2015] DTMAC: A Delay Tolerant MAC Protocol for Underwater Wireless Sensor Networks, IEEE Sensors Journal, DOI 10.1109/JSEN.2462740.
[7] Injong R, Ajit W, Mahesh A, Jeongki M. [2005] ZMAC: a Hybrid MAC for Wireless Sensor Networks, ACM 159593054X/ 05/0011.
[8] Maaz M, Mohiuddin, Adithyan I, Rajalakshmi P. [2013] EEDF-MAC: An Energy Efficient MAC Protocol for Wireless Sensor Networks, International Conference on Advances in Computing, Communications and Informatics.
[9] Lei T, Yanjun S, Omer G, David B. [2011] Johnson EM-MAC: A Dynamic Multichannel Energy-Efficient MAC Protocol for Wireless Sensor Networks, ACM 978-1-4503-0722-2.16–19.
[10] Geethanjali S, Pravin renold A. [2013] Multi-channel mac protocol for energy saving in wireless sensor networks, International Journal of Smart Sensors and Ad Hoc Networks (IJSSAN). 3(1):2248-9738,
[11] kancherla V, Ramesh babu P, Nirupama P. [2014] RPMAC: A Novel Receiver Pivotal MAC Protocol Event Driven Wireless Sensor Networks, International Journal of Advance Research in Computer Science and Management Studies. 2(11).
[12] zlem Durmaz Incel O, Pierre J, Sape M. MC-LMAC: A Multi-Channel MAC Protocol for Wireless Sensor Networks.
[13] Yang X. [2012] Senior Member, IEEE, Miao Peng, John Gibson, Geoffrey G. Xie, Ding-Zhu Du, and Athanasios V. Vasilakos, Senior, Tight Performance Bounds of Multihop Fair Access for MAC Protocols in Wireless Sensor Networks and Underwater Sensor Networks, IEEE Transactions on mobile computing. 11(10).
[14] Mohan R, Rajan C, Shanthi N. [2012] A Stable Mobility Model Evaluation Strategy for MANET Routing Protocols. International Journal of Advanced Research in Computer Science and Software Engineering. 2:58-65.
[15] Michael B, Gary V, Yee, Eric A, Richard H. [2006] X-MAC: A Short Preamble MAC Protocol for Duty-Cycled Wireless Sensor Networks, ACM 1-59593-343-3/06/0011, 1–3.
[16] Hai-Heng N, Wee-Seng S, Mehul M. [2015] Saturation Throughput Analysis of the Slotted BiC-MAC Protocol for Underwater Acoustic Networks, IEEE Transactions on wireless communications. 14(7).
[17] Shuguo Z, Zhi W, Ye-Qiong S, Zhibo W, Luis A. iQueue-MAC: A Traffic Adaptive duty-cycled MAC Protocol With Dynamic Slot Allocation.