MODIFIED MAC PROTOCOL FOR LOW OVERHEAD AND LONG DELAY UNDERWATER ACOUSTIC COMMUNICATION

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ABSTRACT
Efficient underwater networking is still a challenging issue due to its physical limitations, like long propagation delay. In this paper, we focus on modified medium access control (MAC) for low overhead and long delay Underwater Acoustic Communication. Here we considering that the handshaking process in conventional contention-based MACs is the main problem for improvement of utilization of the network channel, we propose a modified MAC protocol with Combined and Cancellation of CTS and RTS process to reduce the time overhead, and to achieve more efficient channel utilization. In Modified MAC protocol the conventional two-way handshaking is decoupled, and hence relevant nodes are able to perform other transmissions while control packets are propagating in water. Modified MAC also saves unnecessary control packets with traffic prediction, further improving the PDR and throughput. Our proposed protocol has been proven to be channel-efficient with both theoretical analysis and intensive simulations.

INDEX TERMS: CTS, MAC, PDR,RTS, Throughput

INTRODUCTION
Underwater Acoustic Sensor Networks (UW-ASN) [1], which will enable a variety of aquatic applications, has been actively investigated over the past decade. However, efficient underwater networking is still a challenging open problem due to the adverse underwater environment. As radio signals do not propagate well in water, underwater communications feature acoustic signals, bringing distinctive properties and challenges in underwater communications and networking. The propagation delay is 5-order longer than RF signals, and therefore is dominant in the total communication time. For example, considering transmitting a 64-byte packet to a node 500 meters away, the propagation delay is approximately 333 ms while the transmission time is 50 ms (at 10 kbps).

Therefore, better utilizing the propagation time will significantly help improve the network throughput, especially in UW-ASNs where the data transmission rate is low. [2]Medium Access Control (MAC) layer sits right above the physical layer (PHY) and manages the shared communication medium, by coordinating the access times of a number of nodes. Therefore, it has great impact on network performances, including delay, throughput, fairness, and energy consumption. Underwater MAC[4] has to be designed to suit the physical media properties underwater environment. We focus on making the coordination and handshaking process between nodes more efficient. In the underwater environment, the network topology can be changed by several causes, including node mobility with water currents, link disruptions due to poor acoustic channels, and failures of node hardware. Contention-based random access MAC protocols can react to network dynamisms well, as they do not need to maintain much neighbor information and links are established on-demand.

However, adopting contention-based MAC protocols in [3]UW-ASNs will result in poor performance. First, the two-way handshaking before data transmission in contention-based MAC protocols introduces large propagation delay overhead. When collisions happen during the handshaking process, the delay will be even longer and more energy is required for retransmitting. Second, during the handshaking process, the involved nodes (neighbor nodes of the sender and/or the receiver) cannot transmit, resulting in a large waste of communication channel and consequently low network throughput.

LITERATURE SURVEY

Tiansi Hu and et al [1], they have indicated in their paper that the efficient and reliable underwater acoustic networking is still a challenging issue due to its physical limitation. They focus on medium access control (MAC) for underwater acoustic sensor networks (UW-ASNs). Considering that the handshaking process in traditional contention-based MACs is the main hurdle for improving the network channel utilization, they formed a novel MAC protocol with Decoupled and Suppressed Handshaking (DSH-MAC) in order to reduce the time overhead, and therefore achieve more efficient channel utilization. In DSH-MAC the conventional two-way handshaking is decoupled, and hence relevant nodes are able to perform other transmissions while control packets are propagating in water. DSH-MAC[1] also suppresses unnecessary control packets with traffic prediction, further improving the channel utilization and throughput.
Akyildiz, Dario Pompili and et al [2] they have shown in their paper that the several fundamental key aspects of underwater acoustic communications are investigated. Different architectures for two-dimensional and three-dimensional underwater sensor networks are discussed, and the characteristics of the underwater channel are detailed. The main challenges for the development of efficient networking solutions posed by the underwater environment are detailed and a cross-layer approach to the integration of all communication functionalities is suggested. Furthermore, open research issues are discussed and possible solution approaches are outlined.
Yutao Ma and et al [3] they have suggested in their paper that the the high bit-error, high transmission energy cost, and complex multi-path effects in underwater environment make it even harder. In this paper, a suitable MAC protocol, named C-MAC (cellular MAC) for underwater acoustic sensor networks (UWANs) is proposed. C-MAC is a TDMA based MAC protocol, which divides networks into many cells. Each cell is distributed a time slot; nodes in a cell, can only transmit packets in the cell's time slot. Experiments show the protocol can avoid collision, minimize the energy consumption, and increase the throughput efficiency.
Min Kyoung Park and et al [4], they shown in their paper that under a realistic underwater sensor network scenario, our MAC protocol wastes only 4% of the transmit energy and only 1.5% of the receive energy due to collisions, when the average number of neighbors is four, and the duty cycle is 0.004. This distributed, scalable MAC protocol has the potential to serve as a primer for the development of energyefficient MAC protocols for future underwater sensor networks
Peng Xie and et al [5] they have indicated in their paper that the Underwater sensor network are significantly different from terrestrial sensor networks in that sound is mainly used as the communication medium. The long propagation delay and limited bandwidth of acoustic channel make the existing MAC protocols designed for radio networks either unpractical or not energy efficient for underwater sensor network. They defined reservation based MAC protocol (R-MAC) Furthermore they scheduling algorithms allow nodes in the networks to select their own schedules, thus loosening the synchronization requirements the protocol. Additionally, R- MAC supports fairness. They used the simulation and shown the fairness and throughput.

PROPOSED WORK

I] METHODOLOGY

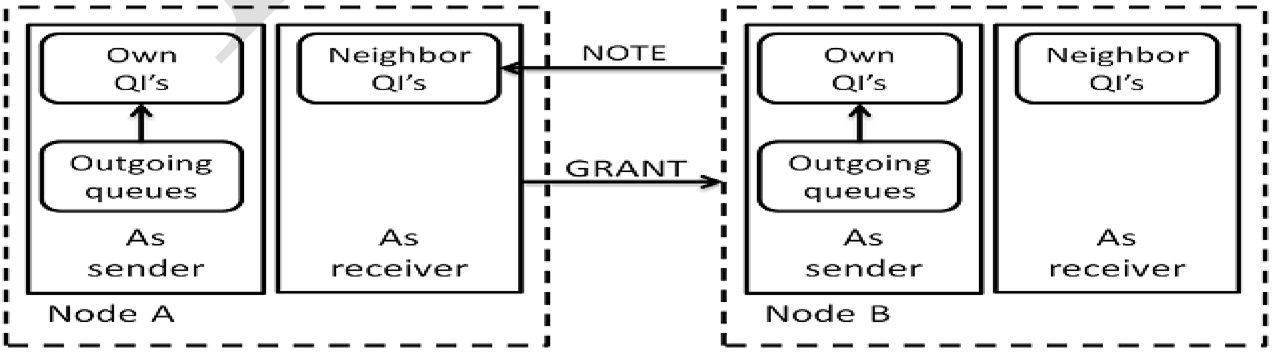

Figure 1:- Block Diagram of Components in proposed modified MAC Protocol

To achieve fairness, a receiver should not choose a sender arbitrarily. Instead, it should choose the sender that has the highest urgency, e.g., with the most packets and the highest queuing delay. We introduce a metric named queue index QI(A,B)[1] that evaluates the urgency of outstanding transmissions from node A to node B. QI indicates both the length of the queue and the age of the packets, and it varies along data transmissions. Dissipating the packets in a queue, i.e., transmitting them will lower the QI and therefore give chances to other neighbors. Neighbors with few packets and low generation rates will eventually obtain the channel grant instead of being starved, because the packet ages increase as the time elapses.

II] WORKING METHOD

THE SENDER

The MAC protocol on the sender addresses the issue of when to notify its neighbors (potential receivers) of its queue's status so that each receiver can schedule when to start a data transmission between them. A NOTE packet from sender node A to receiver node B (denoted as NOTE(A,B)) contains the following values:

- QI(A,B): the queue index. It is the sum of queuing time of all the buffered packets for node B. The higher the QI, the more urgent to send.
- N and ΔN: number of packets for node B in A's outgoing queue, and the average packet generation rate for node B, respectively. They are used for node B to extrapolate node A's time varying QI(A,B) during the time that no NOTE transmission takes place between node A and B. Both values are non-negative.
- A NOTE packet is sent by node A in two cases:
- A NOTE packet is always piggybacked with a data packet or merged into its packet header, so as to inform neighbors of the sender's queue status without extra propagation delay
- The sender A realizes that the receiver B has an inaccurate estimation of QI(A,B).
- A NOTE packet is sent by node A in two cases: 1) a NOTE packet is always piggybacked with a data packet or merged into its packet header, so as to inform neighbors of the sender's queue status without extra propagation delay; 2) the sender A realizes that the receiver B has an inaccurate estimation of QI(A,B).
- The first case is straight-forward For the second case, there are two indicators that node B has an inaccurate estimation of QI(A,B) - absence of GRANT packets from B when the channel is idle or GRANT is given to a lower-priority neighbor of B.

THE RECEIVER

- In Modified MAC, the receiver node needs to initiate data transmissions from its neighbors intelligently, based on the QI's received and its own estimations.
- Every node in the network should periodically estimate whether their neighbors have data packets to send. As there may be a gap between the time the receiver receives a NOTE packet from the sender and the time it sends a GRANT packet to the same sender.
- Therefore, the receiver has to project A's queue change in order to make a good decision on choosing the most urgent node.
- When the channel is idle, the node checks whether there are any neighbors with packets to send according to its own estimation of QˆI's. If then, it picks the neighbor Nmax with the highest QˆI and grants the channel to node Nmax by sending a GRANT packet.
- The GRANT packet contains the current node ID (receiver), the ID of the selected sender, and the associated QˆI between them, which is used by other overhearing neighbors of the receiver to compare with their own QI with and trigger update NOTE if estimation inaccuracy is detected.
- The receiver does not send GRANT packets to a node with QˆI < QImin, which is set to 1.0. The transmission between the sender and receiver can be restarted either after QˆI goes up above QI min or the sender sends a update NOTE to the receiver as in the case of absence of GRANT packets.
- As the total queuing time changes over time, the receiver should estimate the current QI value between it and the associated neighbor with first-order extrapolation

COMPARISON OF MODIFIED MAC AND REGULAR MAC

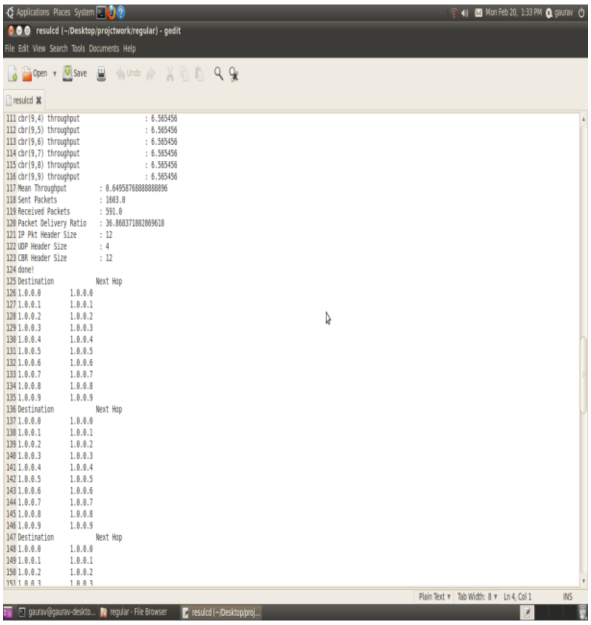

Figure 2:- Result file of Regular Mac Protocol

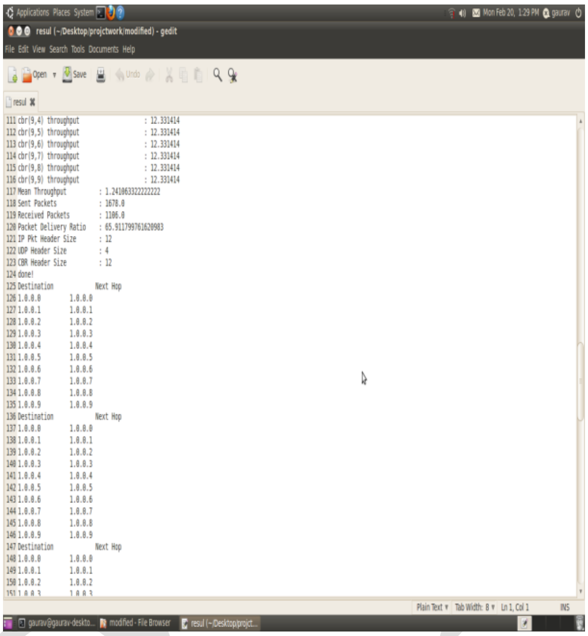

Figure 3:- Result file of Modified Mac Protocol

As we checked the above snapshots first snapshot shows the the result of regular MAC and second snapshot shows the results of modified MAC. Following table shows tabular comparison of output parameters.

Table 1:- Comparison Regular MAC modified MAC

Point	Regular mac	Modified mac
Number of Nodes	10	10
Packet Size	125bytes	125bytes
CBR Period	60s	60s
Mean Throughput	0.6495	1.2410
Sent Packets	1603	1678
Received Packets	591	1106
Packet Delivery Ratio	36.86	65.9117

The above table shows that the study of the Regular MAC results and Modified MAC Rresults We taken the 10nodes. Packet size is 125 bytes and the cbr(constant bit rate) period is 60s Simulation length is taken as 99999s,transmitter frequency is 100000.0 Hz and transmitting bandwidth is taken as 10000.0 Hz and bit rate is taken as 4800.0 bps Then in terminal we have to execute the instruction ns uwcbr.tcl packet size cbr period i.e. **ns uwcbr.tcl 125 60** if we execute or run this command we get the output as shown in the figure.

PDR (Packet Delivery Ratio) =No of successful packets received/Total packets sent
Mean Throughput [kb/s] =Total no of packets delivered successfully within specified time×packet size/1000

Overall Analysis And Comparison of Protocols by Using 10,20,30,40,50 Nodes

- Q.I =Total no of packets in particular node's queue
- Throughput=Total no of packets delivered successfully within specified time*packet size/1000
- PDR=Total no of packets delivered successfully/Total packets sent

- E TO E Delay=∑Individual Packet Delay/No of Packets
- Routing Overhead=Total no of Routing Control Packets/Total no of Packets

EXPLANATION

Table no 2:- Comparison of Queuing Index (QI) of Regular MAC modified MAC

Number of Nodes	Regular MAC	Modified MAC
10	20	upto2
20	40	upto10
30	60	upto15
40	80	upto20
50	100	upto30

Table no 3:- Comparison of Throughput in MbPS

Number of Nodes	Regular MAC	Modified MAC
10	0.64	1.24
20	0.12	0.25
30	0.05	0.10
40	0.02	0.05
50	0.019	0.040

Table no 4:- Comparison of PDR(Packet Delivery Ratio) in Percentage

Number of Nodes	Regular MAC	Modified MAC
10	36.86	65.91
20	14.56	28.2
30	8.66	18
40	6.15	13.61
50	5.09	11.52

Table no 5:- Comparison of E To E Delay in Seconds Of Regular MAC modified MAC

Number of Nodes	Regular MAC	Modified MAC
10	3.73s	0.55s
20	3.34s	2.65s
30	3.28s	3.11s
40	3.37s	3.15s
50	3.73s	3.24s

Table no 4.7 Comparison of Routing Overhead in Percentage

Number of Nodes	Regular MAC	Modified MAC
10	12.46	10
20	21.66	10.21
30	25.97	12.38
40	28.28	13.60
50	29.54	14.34

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GRAPHICAL ANALYSIS (REAL TIME GRAPH)

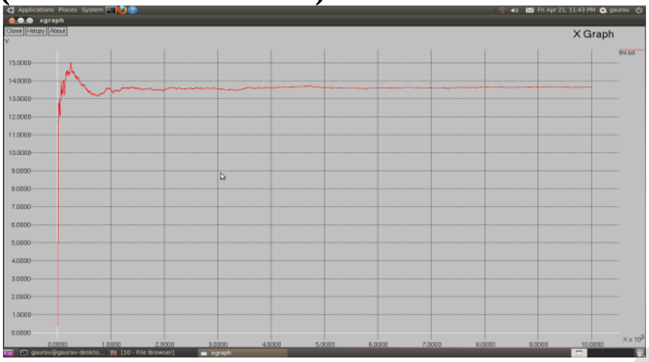

Figure 4:- Real Time Graph of Modified MAC

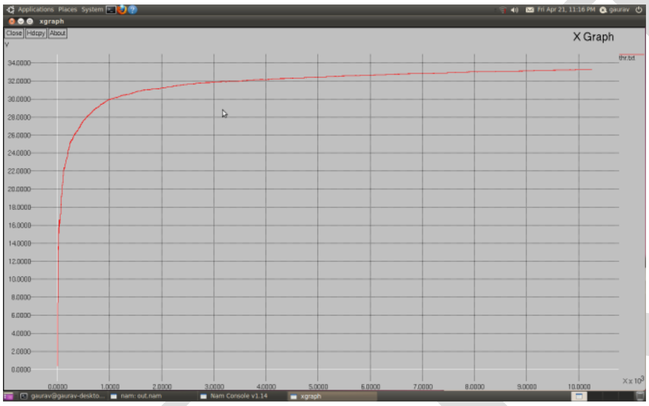

Figure 5:- Real Time Graph of Regular MAC

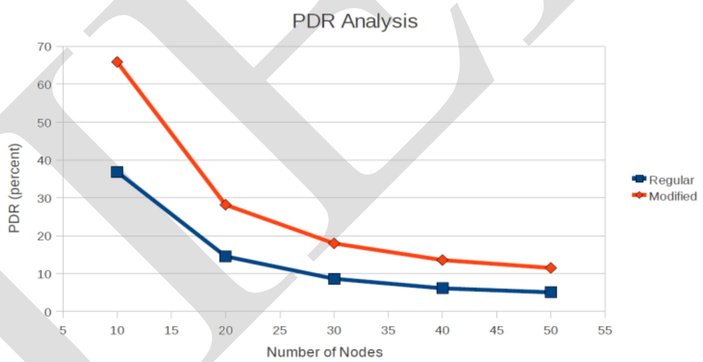

Figure 6:- Graph of PDR Comparison of Regular MAC and Modified MAC

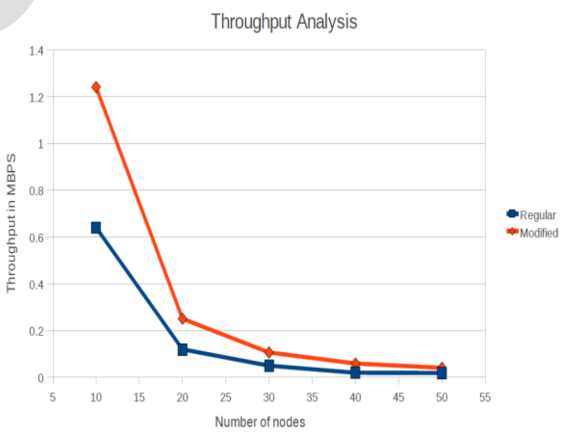

Figure 7:- Graph of Throughput Comparison of Regular MAC and Modified MAC

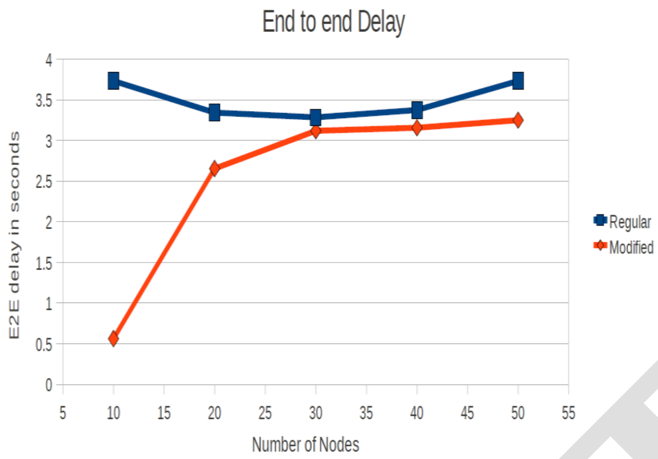

Figure 8:- Graph of End To End Delay Comparison of Regular MAC and Modified MAC

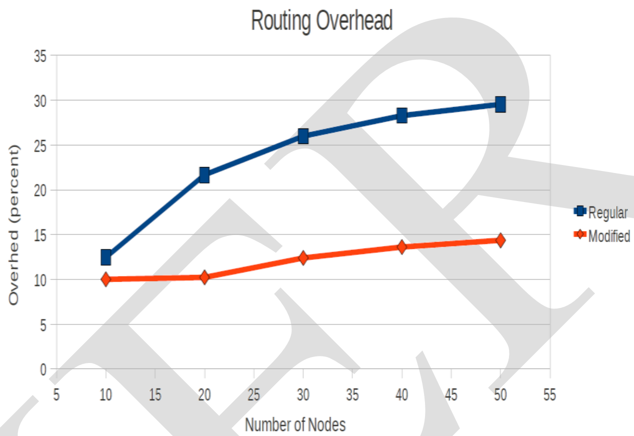

Figure 9:- Graph of Routing Overhead Comparison of Regular MAC and Modified MAC

CONCLUSION

With the Implementation of Modified MAC protocol all the parameters namely Throughput, PDR, End To End Delay, Routing Overhead, Q.I. are Analyzed and on the basis of result, output values, graphs we have concluded that performance of modified MAC protocol is improved than the regular MAC protocol.

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