Reliable Mac Sensing Protocol for Underwater Sensor Networks

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Abstract- The proposed CDMA based Medium Access Control (MAC) Protocol multihop wireless network that uses multiple channel and dynamic channel selection method. The comparisons is conceded out by means of analytical models, which are used to confine the activities of a node that acts according to either considered specifically for the underwater acoustic environment ,APCAP,DACAP and T-Lohi.the focus is on throughput delay and energy performance (traffic load ,node density ,single and multihop topologies).The results mainly highlights relevant design tradeoffs that can be exploited in order to properly tune protocol performance .These results allow understanding which protocol is more suited to given network setting ,and are expected to be of help in designing novel protocol that possibly outperform currently available solutions**.**

Index Terms- Medium Access Control, Underwater acoustic sensor networks, sonobuoys

1. INTRODUCTION

Underwater mobile communications is an important area of research in the field of underwater technology. With the brisk advance of submarine and underwater acoustic *sensor networks* (UWA) data communication, the present development trend is the construction, the present development trend is the construction of net comprising mobile and fixed nodes [1]. The environment of mobile UWA communication is Made more complicated is made more complicated by the existence of Doppler effects and multi-path phenomena. There is an urgent need for research on high-performance mobile UWA communication techniques. Underwater mobile communications are used in the field of ocean monitoring to detect tectonic movements, incoming tsunamis and water pollution [2].

The main focus of the work is about monitoring underwater safe co_2 storage and remote control of submarine oil Extraction using medium access control (MAC) protocol. Geologic storage of carbon dioxide (co_2) is the underwater disposal of co_2 from large industrial sources such as power plants .carbon capture and storage (CCS) also known as carbon capture and restoration, includes geologic cargo space as one of its components [1].CCS is a powerful tool along with energy competence, fuel switching as well as renewable power sources essential to reducing atmospheric co2 levels. Many surveys show that the most effective and least costly way to reduce co_2 levels to avoid climate change is to use all co_2 reduction tools; including ccs. However the burning fossils fuels is increasing co_2 levels in the atmosphere above naturally occurring levels, contributing to global climate change.

The geological carbon capture and storage (CCS) techniques consist of capturing co_2 from power and industries activities and storing it in subterranean geological. Consumption of underwater nodes that testimony data during the monitoring mission, and then recover the instruments to retrieve the data. Wiring of the underwater nodes to a surface station in order to draw together the data on-line and in real time [2].

Underwater $co_{2.}$ Storage infrastructures decreasing the costs of underwater monitoring while at the same time providing higher flexibility than existing systems. Nodes in the network are connected via Acoustic links in an underwater sensor network which provides robust, real life communications of the monitoring data both in single hop and multi hop deployments [1][2].The solutions allow collecting data and sending instruction to the devices deploy in the set of connections different devices in the network. The paper is structured as follows. Section II describe the literature survey to facilitate we have investigated. The associated work in Section III. The concert evaluation and methodology is investigated within Section IV. As a final point, Section V concludes the paper.

2. LITERATURE SURVEY

Pressure Routing for Underwater Sensor Networks a SEA Swarm (Sensor Equipped Aquatic Swarm) is a sensor cloud that drifts with water currents and enables monitoring of local underwater events such as contaminants, marine living and intruder [3]. The goal is to design an efficient any cast routing algorithm for reliable underwater sensor event reporting to any one of the float up sonobuoys. Main challenges are the ocean current as well as the Limited possessions (bandwidth and energy [3]). Addressing these challenges and proposes Hydro Cast, a hydraulic pressure based any cast routing protocol that exploits the measured pressure levels to route data to surface buoys.

An Energy-Efficient MAC Protocol for Wireless Sensor Networks. S-MAC, a medium-access control (MAC) protocol designed for wireless sensor networks. Wireless sensor networks use [4] Battery-operated computing as well as sensing procedure. A expect sensor networks to be deployed in an adhoc fashion, with individual nodes remaining largely inactive for elongated periods of time but subsequently flattering ,gradually active when something is detected. Wireless MACs energy conservation and self-configuration are most important goals, despite the fact that per-node fairness and latency are not as much of important [4].In conclusion, S-MAC applies message passing to reduce contention latency for sensor-network applications that require store-and forward processing as data move through the network.

Propagation-delay-tolerant MAC Protocol for Underwater Acoustic Sensor network. Underwater acoustic sensor networks (UASN) can be employed in a vast variety of applications, retrieving exact and up-to-date information commencing underneath the oceans Surface. While broadly used by terrestrial sensor networks, radio frequencies (RF) do not propagate well underwater [5]. Acoustic channels are therefore employed as an alternative to support long-distance and low-power communication in underwater sensor Networks even though acoustic signals suffer from long propagation delay and have very limited bandwidth.

An adaptive propagation-delay-tolerant collision-avoidance protocol (APCAP) for the MAC sub layer of UASN. The protocol includes an improved handshaking mechanism [5] that improves efficiency and throughput in UASN where there is a large propagation delay. In addition, it also allows a node to utilize its idle time whilst waiting for messages to propagate, which is otherwise washed out by most existing MAC protocols, exhibits good performance and outperforms the other MAC protocols.

Distance Aware Collision Avoidance Protocol for Ad-Hoc Underwater Acoustic Sensor Networks. A channel access protocol for ad-hoc underwater acoustic networks which are characterized by long propagation delays and unequal transmit/receive power requirements. The protocols save broadcast energy by avoiding collisions while maximizing throughput [6]. It is based on minimizing the duration of a hand-shake by taking the advantage of receiver tolerance to interference when the two nodes are closer than the maximum transmission range [6].

This protocol achieves a throughput several times higher than that of the Slotted FAMA, while contribution comparable savings in energy. Even though carrier sensing ALOHA offers an elevated throughput, it wastes much more power on collisions

DOTS: A Propagation Delay-aware Opportunistic MAC Protocol for Underwater Sensor Networks Underwater Acoustic Sensor Networks (UW-ASNs) use acoustic links as a means of communications,[7] low bandwidth, and high transmission power consumption. A proposed the Delay-aware Opportunistic Transmission Scheduling to increase the chances of concurrent transmissions while reducing the likelihood of collisions. DOTS achieves better channel utilization by harnessing both temporal, and spatial reuse when allows out of- order packet delivery and packet trains at the sender side [7] Second, consideration is to capture effect as in

Interference Aware (IA) MAC [7] where a receiver can correctly decode a packet even in the presence of other concurrent transmissions. Third, when a data frame is correctly received but the corresponding ACK gets lost due to lossy channel or collision, Windowed ACK [7] can help contain the number of spurious retransmissions and increase the throughput. Fourth, the impact of mobility and random topologies on the throughput and fairness will be carefully investigated. The table1 below indicates the comparison table for MAC related protocols.

PURPOSE AND METHODOLOGY	MERITES	DEMERITES	APPLICATIONS
Pressure Routing for Underwater Sensor Networks In geographic routing, a packet is greedily forwarded to the closest node to the destination in order to minimize the average hop count.	Hop count is decreased	Packet losses increased, reliability reduced	WI-FI satellite
An Energy-Efficient MAC Protocol for Wireless Sensor Networks. To achieve the primary goal of energy efficiency to identify what are the main sources that cause inefficient use of energy trade-offs to reduce energy consumption	reducing energy consumption	Transmission delay	low-power radios,
A Propagation Delay-aware Opportunistic MAC Protocol for Underwater Sensor Networks. To boost the chances of concurrent transmissions while reducing the likelihood of collisions.	minimize data packet, Energy consumption	long propagation latency and the severely limited bandwidth of acoustic communications.	wireless satellite links, oil and chemical spill monitor, submarine detection, and Surveillance.
Design of a Propagation-delay-tolerant MAC Protocol for Underwater Acoustic Sensor. The protocol includes an enhanced handshaking method that Improves effectiveness and throughput in UASN where there is a large propagation delay.	Compulsory maximum latency	RF signals deliver very poor performance underwater	onshore applications

TABLE1: COMPARSION TABLE FOR MAC RELATED PROTOCOL

3. RELATED WORKS

There has been intensive research on MAC protocols for terrestrial ad hoc [15] and wireless sensor networks [13. For example, channel access control in underwater acoustic sensor networks poses challenges such as the limited bandwidth, very high and variable propagation delay, channel asymmetry, in addition to the serious multipath and vanishing phenomena. The design of a MAC protocol is challenging for the operation of energy-limited sensor nodes in UWASNs due to energy limitations, long propagation delays, and low data rates and so on. The propagation speed of sound in underwater is on the subject of 1500m/s. Therefore, propagation delay in underwater channels is five orders of magnitude higher than that in radio frequency (RF) terrestrial channels, and extremely variety that depends on temperature, salinity, and depth, while propagation delay is negligible for short-range RF. Long propagation delay is the main character of UWASNs [18], two scenarios will be considered here. In the

First scenario, the transmitted packet from a transmitting node has to be received by all the other sensor nodes within the communication range broadcasting locally gathered information, which we call B-MAC. In the second scenario, it has to be received by all the sensor nodes in the communication range of the transmitter excluding the nodes which have packets to send, (e.g., broadcasting Localization packets from anchors), which we call L-MAC [13].The design of a MAC protocol is challenging for the operation of energy-limited sensor nodes in UWASNs due to energy limitations, long propagation delays, and low data rates and so on. All these factors play an important role on control algorithms of MAC protocols the goal of the network is to minimize the time duration of the broadcasting (or localization) task which is defined as the time of collision-free transmission of all packets from the transmitting nodes. If we assign a waiting time to each transmitting node which can be interpreted as the time that a node has to wait to transmit its packet, the problem can be formulated as

$$\min_{k\in[1,2,\dots,k]} \max . wk + . \frac{b^k}{R^k} \quad (1)$$

S.t. $w_{k\geq 0,}$ *and collision –free transmission*.

Where wk is the waiting time of node k, and Rk is the data rate at which node k transmits its packet[16].The propagation speed of acoustic signal in underwater environment is about 1500m/s. Offered load and Throughput are employed to measure the performance of various protocols in this paper, which are define by and respectively [14].

$$\text{O L} = \frac{\frac{\text{total data packets transmitted}}{\text{simulation time}}}{\frac{\text{signalling rate}}{\text{data packet size}}} \quad (2)$$

(OL is Offered Load)

$$\text{throughput} = \frac{\frac{\text{total data packet recieved}}{\text{simulation time}}}{\frac{\text{signalling rate}}{\text{data packet size}}} \quad (3)$$

In addition, showed that the performance of a MACA-like protocol that employs RTS/CTS handshaking is also severely constrained by a long propagation delay. The ratio of the propagation delay to the frame length as

$$\alpha = \frac{P}{\frac{K}{\text{datarate}}} = \text{datarate}\frac{P}{K} \quad (4)$$

Where P is the propagation delay, and K is the size of a frame in bytes throughput delivered by CSMA decreases as increases (that is, as the data rate increases in the normalized simulations). This means that for a certain propagation delay, CSMA delivers a higher throughput if nodes. Transmit at a lower data rate. In the meantime, handshaking delivers [18] even lower throughput than CSMA at the same data rate, though almost negligibly so. This is because handshaking incurs extra RTS and CTS frames prior to sending a data frame; and worse, when handshaking fails, the time spent on propagating the control frames (i.e., RTS and CTS frames) is wasted.

4. PROPOSED APPROACH

To support the retrieval of accurate and up-to-date information from beneath the world's oceans, it is desirable to organize underwater sensor networks The Propagation Delay Aware Protocol (PDAP) uses the RTS/CTS mechanism for channel reservation and transmission. All nodes are synchronized. Similarly to APCAP, when a node has a data packet to transmit, it checks its own schedule to find free times for the whole communication exchange; namely, for sending the RTS, receiving the CTS, and sending the data packet[14]. The time for receiving the CTS must start after the time needed for the RTS to reach the destination plus the time for the CTS to get back.[10]. This waiting time is randomly and uniformly chosen in [0, T], where T = 2 ^txRetry (2*maxDelay + rtsTime). When it is time to send the RTS a node checks the channel. If it is idle, the node sends the RTS and waits for the CTS. Otherwise, the sender clears its schedule (RTS, CTS and data packet times), increases its retry counter and selects new times for sending the RTS, receiving the CTS and for sending data. Both RTS and CTS control packets contain information about [11] the distance between the source and destination. This distance is computed based on the channel propagation delay and the time stamps on the control packets. Therefore, this information is updated every time nodes communicate. The RTS is 15Bytes long and the CTS are 9Bytes. When a potential interferer receives a control packet from a neighboring node, in case it has scheduled a transmission that could collide with ongoing communication it updates its own schedule and delays its transmission [16] Reception of RTS and CTS by a possible interferer is dealt with as follows. When the interferer receives an RTS packet, it sets its NAV so that it will not be transmitting control information that would arrive at the sender at the scheduled CTS reception time. It also will not transmit a control packet that would arrive at the destination while the destination is sending the CTS similarly; the interferer will not transmit control information that would arrive at the sender during the transmission of the data packet and at the destination while it is receiving the data [19]. When the interfering node receives the CTS, it updates its NAV according to the reception time carried on the CTS. As a consequence, the interferer will not transmit control information that would arrive at the destination during the reception of the data packet, and at the source during the data transmission. Although trying to schedule the highest possible number of parallel transmissions [7], nodes always attempt to avoid collisions and that senders are synchronized when transmitting packets.

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5. EXPERIMENTAL SETUP

The hardware setup includes Pentium IV processor of 1GB RAM with 2.7GHZ of processor speed The test beds use VMware Workstation that performs testing and development environment NS-2 is n event driven packet level network simulator developed as a part of the VINT project (Virtual Internet Test bed). The Ns-2 with C++/OTCL integration feature, Object oriented Tcl (OTcl) called as a scripting language. It is an open source software package available for both Windows 32 and Linux platforms. NS2 uses two languages because simulator has two different kinds of things it needs to do. On one offer, exhaustive simulations of protocols require a systems programming language which can efficiently operate bytes, packet headers, and execute algorithms to facilitate to run over large data sets.

***4.1. Single hop networks*:**

Table 2: Received data packets (low traffic)

NUMBER OF PACKETS	DACAP	T-LOHI	PDAP
0.02	-	5	90
0.04	-	-	92
0.06	-	-	94
0.1	-	-	-
0.12	8	-	-
0.14	-	-	-
0.16	-	-	-
0.18	7	-	95

Table3: Received data packets (high traffic)

NUMBER OF PACKETS	DACAP	T-LOHI	PDAP
0.4	85	-	-
0.6	60	91	-
0.8	40	95	60
1	30	80	50
1.2	20	-	-

***4.2. Multi hop networks*:**

Table 4: Latency with low traffic

NUMBER OF PACKETS	DACAP	PDAP	T-LOHI
0.14	66	81	-
0.16	50	82	-
0.18	30	0	-
0.2	-	-	91
0.22	-	83	-
0.24	-	-	93
0.26	19	-	-

Table 5 Latency with high traffic

NUMBER OF PACKETS	DACAP	T-LOHI	PDAP
0.03	5	-	-
0.05	2	-	-
0.06	-	-	7
0.07	10	-	-
0.08	-	-	-
0.09	-	-	-
0.1	10	-	12
0.11	12	-	-
0.12	15	8	-
0.13	20	-	20

5.1 *Result analysis*

Single-hop: All nodes can communicate to each other directly. **Multi-hop**: Communications from a source to the sink may go through a multi-hop path. The path is determined by a shortest path routing protocol. In the multi-hop setting, the total size of the data packet is situate by the payload plus the headers of the different layers (physical through network APCAP and PDAP fall in the middle in terms of latency, with APCAP commanding lower latencies because of its hostile behavior. PDAP does not have an aggressive policy of channel access. Even though trying to schedule the maximum possible number of parallel transmissions, nodes always attempt to avoid collisions and that senders are matched after transmitting packets

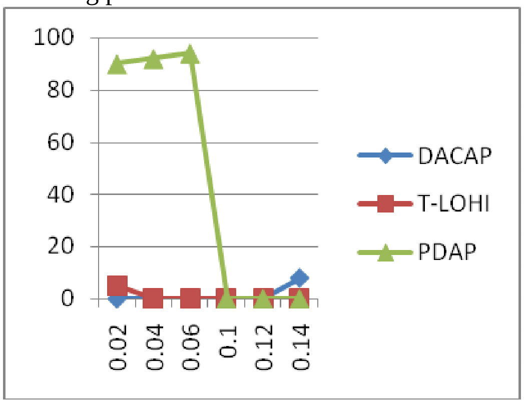

Figure.1. single hop networks with low traffic

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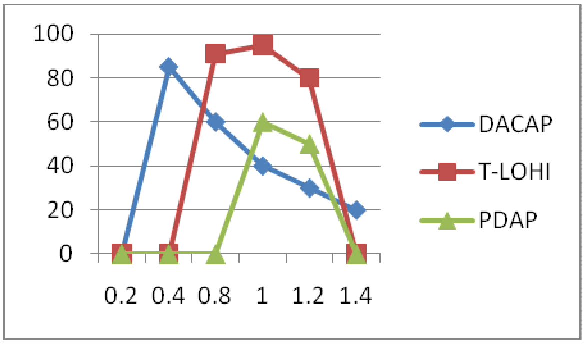

Figure.2. single hop with high traffic

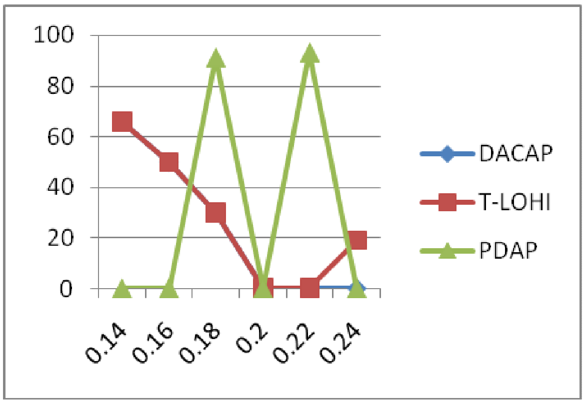

Figure.3. multi hop network with high traffic

6. CONCLUSION

A MAC protocol for UWA networks using transmission range has been chosen so as to maximize the network performance in terms of throughput and delay Future work should concentrate on the development of algorithms for network maintenance and for updating the routing tables of the mobile nodes. Another point that the future work should address is the backoff algorithm. This first version of Slotted FAMA uses a simple backoff procedure. The use of adaptive backoff times (as used in MACAW) should be studied to provide a better performance of the protocol and to favor fairness, mainly in high traffic situations. In long slot situations, the use of simultaneous bidirectional communications should be studied. This means that in situations where the propagation delay is high, transmitter and receiver could send a packet to each other simultaneously without leading to a collision. This could be worn to admit trains of packets, because they have to be acknowledged one by one. Future guidelines of this effort consist of, within fact, the addition of this study through the application of the same analysis methodology to additional MAC protocols, the assessment of analytical results with simulations, and the design of a novel protocol based on the insight provided by analysis

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