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Collision Free Packet Transmission for Localization

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ABSTRACT: Localization is a difficult task of an underwater acoustic sensor network (UASN) which requires multiple packet exchanges. The medium access control (MAC) determines how sensor nodes share the channel for packet exchanging between anchor nodes and target nodes. To obtain the maximum network efficiency for a specific task, various MAC protocols are required for multiple tasks. In existing method using the single anchor node to locate and finding a location of single node at a time, but it produce delay during communications it need more time to find location of entire node. To overcome these issues, an efficient MAC protocol is designed which employs multiple anchor nodes to find localization. It reduces the communication delay by using low complexity algorithm and location aided routing protocol.

KEYWORDS*:* medium access control(MAC), anchor node, dynamic multi-channel packet scheduling ,underwater acoustic sensor node, location aided routing protocol, low complexity algorithm

I. INTRODUCTION

In the recent years, many researchers have investigating underwater acoustic sensor networks (UWASNs) are useful for the oceanic environment monitoring, oceanic geographic data collection, offshore exploration, assisted navigation, disaster prevention and tactical surveillance. The channel of UWASNs has many specific characteristics, such as long propagation delay, low available bandwidth, multi-path transmission, and the Doppler spread, which make different from terrestrial wireless networks.

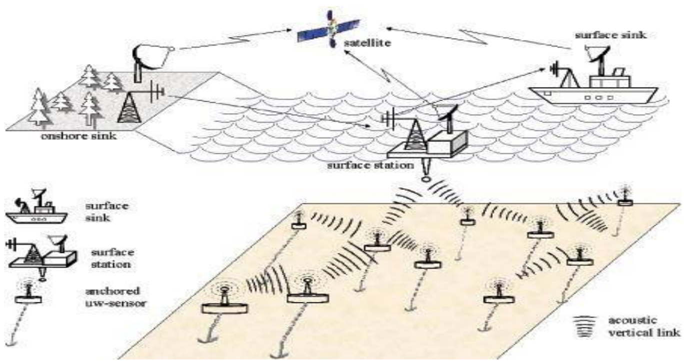

Fig1:2D Architecture of Underwater Acoustic sensor network[2]

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The common communications architecture for underwater wireless sensor network is shown in Figure 1. Sensor nodes in the network may also communicate with a surface station and autonomous underwater vehicle deployed in the underwater sensor network, the location of the sensor nodes need to determine the sensed data. Radio wave Frequency communication does not work well for underwater and the well-known use of GPS is restricted to surface nodes.Hence,packet exchange between the underwater nodes and surface nodes needed for a localization that should carried out using an acoustic communications.UASN acoustic channels have unique characteristics ,long propagation delay, limited bandwidth and multipath interference.. Localization schemes in UASN fulfill the following desirable qualities such as more accurate, fast transmission, wide coverage of communication between nodes and low cost. The nodes are organized in a groups and group has a anchor node to communicate a data transmission to the nearest surface station. In the second level microwave communication is used to collect the information to the surface node and to the land based data to the collection Centre. Once the data reaches the coastal collection center, it can then be relayed to an international collection center via satellite communication (Fig. 1). Major Challenges that follow the model includes limited power, optimization of energy harvesting techniques, increased bit error rates (BER) and low signal to noise ratio (SNR) in case of low power nodes. Efficient routing techniques can play a vital role in controlling the power consumption by employing low power multi-hop transmission provided that the propagation delay do not exceeds the required limits.

In this paper designed to improve network efficiency and also multiple anchor nodes are used to find multiple nodes locations. The low complexity of localization algorithms and location aided routing protocol have been introduced and analyzed in the literature which are relatively different from the ones studied for terrestrial wireless sensor networks. Hamid Ramezani and Geert Leus [1] introduced the concept of dynamic multi-channel packet scheduling, here the network splits the existing channel into several sub channels reduce the scheduling time and minimize the duration of the localization task by using an two low complexity algorithm when most of the underwater sensor nodes does not cover for localization only for single anchors node locate at a time. Hamid Ramezani et al [2] analyzed two classes of packet scheduling in an underwater acoustic sensor network intended to
minimize the localization time based on collision free and collision tolerant schemes. Collision free packet transmission is fully connected in a single hop network on a sequence of each anchor has to transmit immediately after receiving the previous anchor packet and also sequence ordering of packet minimize the localization time only for single hop network. Collision tolerant schemes can able to control the collision guarantee to successful transmission of each anchor nodes in a single hop network. H. Ramezani et al [3] analyzes the localization in an underwater wireless network which has a fixed node and tracking a mobile target target node from acoustic sensor network calculating time-of-flight (ToF) measurements in a underwater environment with a sound speed. Rahman Zandi et al [4] designed for a simple range based localization scheme, calculating received message power comparing with the sending message of the sensor nodes. At this point some losses of messages are obtained due to irregular communication range in the sensor network. M. C. Domingo [5] designed a magnetic induction (MI) technique which reduces the path loss and extends communication ranges in sea water because of transmission range increased moderately, but when acoustic channel is severely degraded magnetic induction technique is more complex. For fresh water it achieves better performance and has been extended to hundreds of meters. B. Gulbahar and O. B. Akan [6] analyzed in terms of basic communication metrics, signal-to-noise ratio(SNR), bit-error rate, and connectivity and communication bandwidth. The performance of 3D networks covering hundreds of meters sea depths and a few km areas that fully connected networks with communication bandwidths extending from a few to tens of KHz. High SNR for networking areas reaches to a few km in deep sea by forming a fully connected and power efficient multi-coil network. The performance dependence of the grid network on inter-coil distance, coil radius, wire diameter and the capacitance is explored. Ameer and Lillykutty Jacob [7] proposed a modified version of stochastic proximity embedding localization algorithm exhibits good performance in the underwater sensor network which uses ranges between all nodes with unknown location. The unknown location nodes cannot find the localization error and measurement error. Wouter van Kleunen et al [8] proposed a MAC protocol designed for time-synchronisation, localization and scheduling communication for small cluster network in underwater node. These three

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aspects with two phases one is coordination phases, it can able to measure the propagation delay between nodes and another is communication phases here the nodes are communicated in a scheduling communication for a sensor network. Both phases can perform the relative positioning of the nodes, a viable approach in underwater and does not for unknown nodes in large cluster networks. J.P. Kim et al [9] designed a MAC protocol that can enable many sensor nodes in large-scale networks to share the limited channel resource is an indispensable component to maximize the localization coverage and speed, while minimizing communication costs. These can be achieved with MAC protocol that requires no node coordination. To emphasis on the impact of MAC protocol comprises a fixed node with a two dimensional network. P. Nicopolitidis et al [10] proposed adaptive push system for acoustic information dissemination of data in an underwater clients to the priori unknown needs of the clients achieving a broadcast schedule and also efficiently combats the problem of high latency of the underwater acoustic wireless environment. Adaptive push system is not affected by the broadcast server. Z. Peng et al [11] introduced a contention-based medium access control protocol with parallel reservation (COPE-MAC) for underwater acoustic networks. Further, COPEMAC protocol designed using a parallel reservation and cyber carrier sensing technique. Parallel reservation method improves the communication efficiency and cyber carrier sensing technique detects and avoids collision by mapping physical channel. Thus the overall system performance, in terms of the system throughput and channel utilization, is improved. C-C. Hsu et al [12] proposed a TDMA (Time Division Multiple Access) based MAC scheduling protocol for energy saving and throughput improvement compared to Spatial-Temporal MAC. This type of protocol cannot design a distributed MAC scheduling scheme that could adapt to traffic and topology change dynamically. M. T. Isik and O. B. Akan [13] analyzed the Three-Dimensional Underwater Localization (3DUL), a 3D localization algorithm for underwater acoustic sensor networks is a distributed, iterative and dynamic solution to the underwater acoustic sensor network localization problem that exploits only three anchor nodes at the surface of the water. K.Kredo et al [14] analyzed the staggered TDMA underwater MAC protocol increases the performance of traditional TDMA by using propagation delay and schedule overlapping transmissions and also synchronized protocol performance good in underwater environment.

II. NETWORK ARCHITECTURE

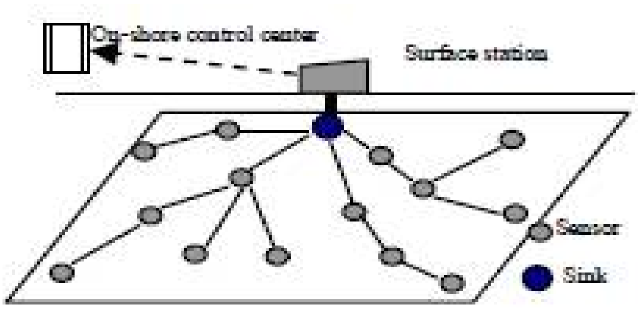

Fig 2: Network Architecture

In the network with architecture as shown in Fig.2, for the information generated at sensor nodes transmits hop-by-hop to the sink in a many-to-one pattern. As packets move more closely toward the sink, the packet collision increases. Because of the long propagation delay and the low available bandwidth in UWASNs, existing contention based MAC protocols with handshake mechanism is not appropriate for their high reserved cost, and existing schedule based MAC protocols is not appropriate for the long slot time. The T-Lohi protocol and the ordered carrier sense multiple access (CSMA) protocol work well in single-hop underwater acoustic

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networks for discarding the handshake mechanism, but they can not obtain high performances in multi-hop networks. In this paper proposed a modified low complexity algorithm produces high performances in multi anchor in multi hop networks.

A. Localization Basics

Localization is one of the most important technologies play a difficult task in many applications especially underwater wireless sensor networks. Localization algorithm classified in to three different categories based on sensor nodes. Stationary localization algorithm, mobile localization algorithm and hybrid localization algorithm. Three kinds of sensor nodes are used in underwater acoustic sensor network: they are anchor nodes, unknown nodes and reference nodes. Unknown nodes are responsible for sensing environment data. Anchor nodes are responsible for localizing unknown node, and reference nodes consist of localized unknown nodes and initial anchor nodes.Currently, many localization algorithms are proposed for underwater acoustic sensor networks. Researchers classify localization algorithm in to two categories: distributed and centralized localization algorithms based on where the location of an unknown node is determined. In distributed based localization algorithm, each underwater sensor nodes can sensed the unknown node and collect the localization information then runs a location estimation algorithm individually.Centralised localization algorithm, the location of each unknown is estimated by a base station or a sink node.

B.Packet scheduling

Packet scheduling in underwater sensor network can be classified in to two types, collision free scheme and collision tolerant scheme.

Collision free packet scheduling: Collision free localization packet scheduling is analyzed where it is fully connected network based on the anchor node. Each anchor node transmits a packet immediately after receiving a previous anchor packet and also there exists an optimal ordering sequence which minimize the localization time. Here fusion center is required to know the position of all anchors, packet loss of a subsequent anchor will not know when to transmit a packet. If an anchor node does not receive a packet from a previous anchor it waits for a predefined time (counting from the starting time of the localization process) again continue the transmission shown in fig3.

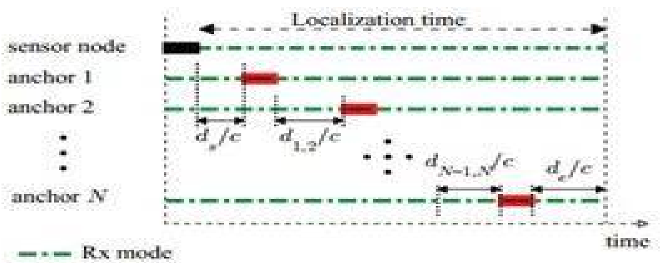

Fig 3: Collision free transmission

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Collision tolerant packet scheduling: During a localization period or receiving a node transmit randomly to avoid a coordination among anchor node in a collision tolerant packet scheduling, anchor node work independently. Packet transmitted from different anchor now collide each other with successful reception shown in fig 4.

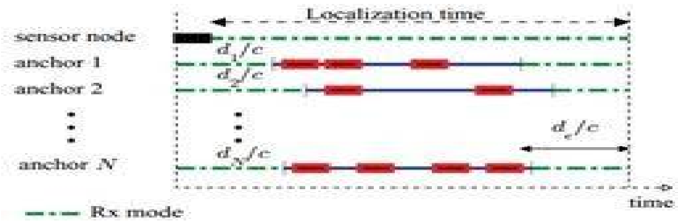

Fig 4: Collision tolerant packet transmission

III. LOCATION AIDED ROUTING PROTOCOL

Location aided routing protocol is used to locate information to reduce the number of nodes to whom route request is propagated. .By using location information, the proposed Location-Aided Routing (LAR) protocols limit the search for a new route to a smaller "request zone" of the network. This results in a significant reduction in the number of routing messages. In energy efficient location aided routing protocol (EELAR) discussed to a wireless base station is used and the network's circular area centered at the base station is divided into six equal sub-areas. At route discovery instead of flooding control packets to the whole network area, they are flooded to only the sub-area of the destination mobile node. The base station stores locations of the mobile nodes in a position table. To show the efficiency of the proposed protocol we present simulations using NS-2. Simulation results show that EELAR protocol makes an improvement in control packet overhead and delivery ratio. LAR utilizes the location information of mobile nodes with the goal of decreasing routing related overhead in mobile and adhoc networks.

IV. LOW COMPLEXITY ALGORITHM

The complexity of the optimal solution (without any heuristic approach), which makes it impossible to be used when the number of anchors is large. In this work, we propose two heuristic algorithms with a smaller complexity that can be adopted for practical applications. The proposed low complexity algorithm has been evaluated in terms of network efficiency, multiple anchor nodes are used to find multiple node locations. It improves the throughput and reduces communication delay.

The suboptimal algorithm is based on a greedy approach, the initial phase, the waiting times of the transmitting nodes are set to zero and it will transmit in the first sub channel. When the waiting time of an anchor nodes are dynamic, it will be removed from the scheduling task. Based on the waiting time, the collision-risk neighbors of the selected anchor are detected, and their corresponding waiting times are modified node can be in sleep mode or idle it can be eliminated, such a way no collisions will occur in the network . It may happen that there are two or more anchors with the same minimal waiting time. In this case, we select the one which has the lowest index as well. Localization process of low complexity algorithm shown in figure 5, explains that if multi anchor nodes are created ,then continue the localization process to reduces the delay otherwise create a node to apply a MAC protocol .The process of creating new multi anchor node is continued ,unless the result is displayed.

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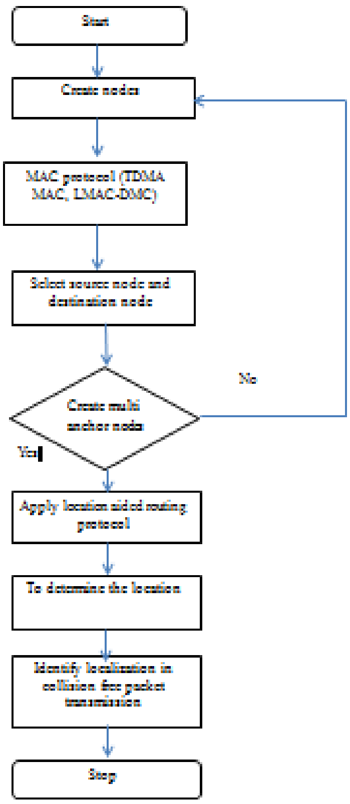

Fig 5: Flow diagram of localization process

V. SIMULATION RESULT AND DISCUSSIONS

We have implemented the decentralized network coding and low complexity algorithms using a network simulator. A packet transmission takes exactly one time unit. We assume that a node can either send or receive and it can only send or receive multiple packets at a time. Nodes have a nominal ratio range of 250m. Transmissions are broadcasted and are received by all neighbors, nodes. The MAC layer is an idealized with perfect collision avoidance. At each time unit, a schedule is created by randomly picking a node and scheduling its transmission if all of its neighbors are idle. This is repeated until no more nodes are eligible to transmit. The simulation area has a size of 1500m×1500m. The number of nodes is 50 which is source node is selected as 12 and destination node is 25. Each node has one information unit to send to all nodes. For the network coding, we use a dynamic field size of node and transport the data the packet scheduling as suggested in collision free packet transmission and collision tolerant packet transmission. All the simulations are performed without this assumption, which reduces the communication delay and improve the network efficiency, improves the throughput and reduces the delay shown in figure 8.The comparison performances of MAC protocol as shown in figure 6, from that TDMA MAC has high performances compared to other medium access protocol.
TDMA MAC protocol reduces the delay and throughput between anchor node and target node as shown in figure 7 and figure 8.The total number of nodes used as 50 transmitting a data of all nodes communicates linearly reduces the delay ,the periodic changes the throughput at certain period reduces the throughput linearly as shown in figure8.

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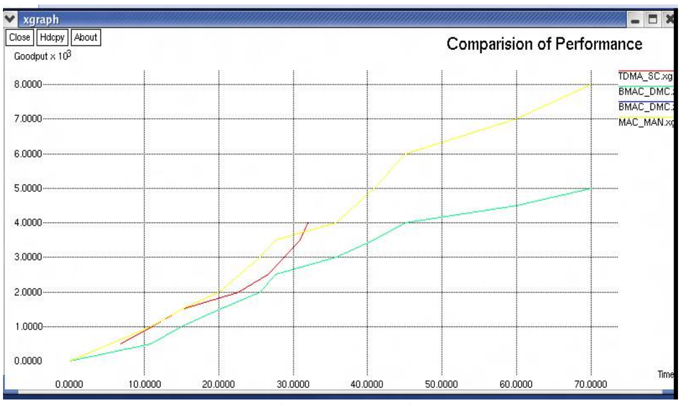

Fig 6: Comparison Performances of three MAC protocols

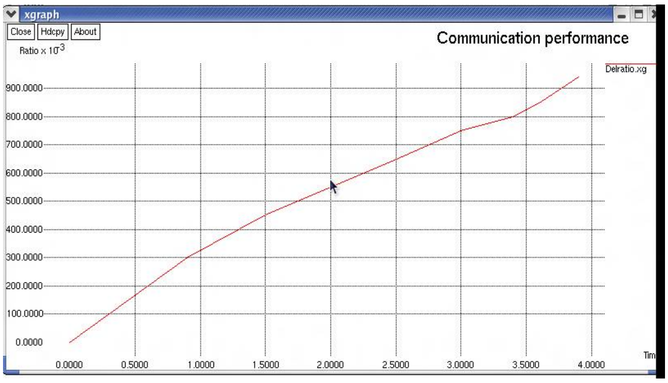

Fig 7: Communication Performances of TDMA with delay

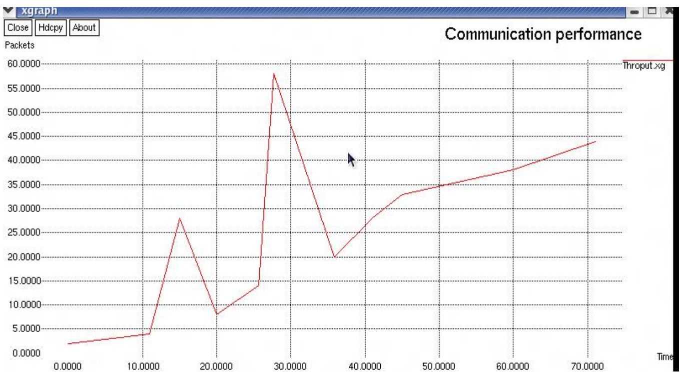

Fig8: Communication performances of TDMA with throughput

VI. CONCLUSIONS

In this work, the problem of scheduling the localization packets of the anchors is formulated in an underwater sensor network. In existing method using the single anchor node to locate and finding a location of single node at

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a time, but it produce delay during communications it need more time to find location of entire node. To overcome this issues design an efficient MAC protocol to improve the network efficiency and multiple anchor nodes are used to find multiple nodes location reduces the communication delay by using low complexity algorithm and location aided routing protocol. The proposed algorithm is low complexity algorithm in order to minimize the duration of the localization task. Moreover, we observed that system adjust the multi anchor nodes dynamically compared high performance in different MAC protocol such as TDMA MAC, BMAC and MAC-MAN (mobile anchor node or sink node).

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