To Increase the Efficiency of Underwater Network using Vector Based Technique

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Abstract: *For the enhancement of underwater acoustic network the current research is focus on communication between various remote instruments to improve the high-rate reliable communication, energy efficiency and robustness. Underwater acoustic are generally formed by connecting ocean-bottom sensors, autonomous under water vehicles, and a surface station. They provide a link to on-shore control center. Underwater acoustic networks are different from ground based networks. They can be deployed for commercial and military applications. Underwater networks consist of a number of sensors and vehicles that are deployed to perform collaborative monitoring tasks over a given area. This paper introduces the research issues of UANs like ranging from energy saving and deployment to different layers and the solutions for these issues.*

Keywords: *Underwater Acoustic Networks, Underwater Acoustic Communication, Energy Efficiency, Robust, Scalable, Cross Layer Design.*

I. INTRODUCTION

Underwater acoustic networks are used for the communication purpose in ocean areas. This approach is used for the long distance ranging network. Underwater acoustic network are formed by establishing two ways acoustic link between various instruments such as autonomous and sensors. To increase the operation rang of autonomous underwater vehicles [3]. The feasible wireless communication rang of autonomous underwater vehicles is limited by acoustic rang of signal modem. Wireless underwater acoustic networking is the enabling technology for these applications. It consists of a variable number of sensors and vehicles that are deployed to perform collaborative monitoring tasks over a given area. To achieve this objective, sensors and vehicles self-organize in an autonomous network which can adapt to the characteristics of the ocean environment. In this research various applications of underwater acoustic network are considered like better communication in which we focus on the information exchange between communicating nodes. The application of underwater acoustic network is environmental monitoring. In this UANs for pollution monitoring [4]. It's also used in underwater explorations. They can be easily done by UANs but difficult for human due to high water pressure.UANs are also used in Disaster prevention. It's done by deploying acoustic sensor network in remote locations.

There are some challenges in the design of underwater acoustic networks like:

- In underwater networks Propagation delay is five orders of magnitude higher then in radio frequency terrestrial channels, and extremely variable [6].
- The available bandwidth is limited in underwater networks.
- Due to multi-path and fading the underwater channel is severely impaired.
- In underwater we have limited battery power. So we have to make them energy efficient.
- To decreases the fouling from underwater sensors.
- Due to the extreme characteristics of the underwater channel High bit error rates and temporary losses of connectivity can be experienced.

II. UAN RESEARCH

MAC layer, Network layer, physical layer and application layer are 4 different issues in UAN Network topology research [5].

A) Network topology: Due to uniqueness of underwater channels and characteristics of acoustic Signal UAN network is different from ground based networks. But the goals of both networks like increasing network capacity, reliable connectivity are same. The layout pattern of connections of various networks is known as network topology. Network topology has two basic types [1]. One is ad hoc mode and the is hierarchy mode. In ad hoc mode nodes are self organized as peer-to-peer network. But in hierarchy network topology several levels of structure are deployed.

B) MAC layer: In network packets are move from one layer to another layer because of MAC layer. Underwater nodes have extremely-limited bandwidth, long delay so they share available resources. Medium access control layer is used to access the underwater acoustic channel [7]. MAC layer schedules each node to access physical medium. MAC layer also setup some parameters and determine resources that physical layer could have.

C) Network layer: Network layer contain the information about the routes. It's responsible for the routing packets and it contains the information of path between sender nodes to destination node. It's having two routing methods one is virtual circuit routing and the second is packet switch routing [8]. In first the network use virtual circuits to Decide the path between sender and receiver. And in second one every node that is part of transmission has its own routing decisions. Now the packet switching has further two types. One is proactive routing and another is reactive routing.

D) Physical layer: Physical layer link with basic hardware and hardware transmission technologies. UAN is unique because of physical channel [2]. For underwater channel electromagnetic wave band have high attenuation but go through only small parts of long-wave bands. So here we need a large antenna and high transmission power. The communication is done in underwater with acoustic signal because acoustic signals can travels at long distance in underwater.

E) Application Layer: Application layer provides the network management protocol. This layer is used for the problem partitioning and resource allocation [10]. It s also use for Synchronizing communication, detecting resource availability and identifying communication partners.

F) Architecture of UANs

There are many unsolved issues in underwater acoustic networks. UANs are different from ground based networks. The bandwidth of UANs is limited as compare to ground based networks [9]. But the acoustic signals are having High frequency and rang. UANs have long propagation delay. Acoustic signal have transmission speed is around 15000m/s which is lower then electromagnetic wave so it delays in progress. Probability of bit error high in cause of UANs. In UANs cost of manufacturing, deployment, recovery and maintained is very high as compare to ground based networks. UANs are design for the long time work and energy saving.

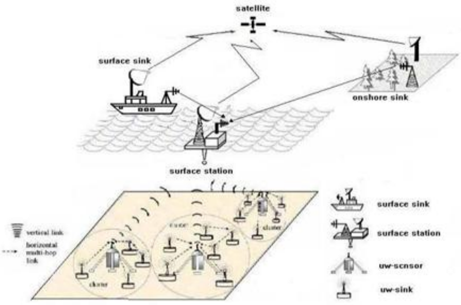

Fig 1: Hierarchy topology

III PROBLEM FORMULATION

Cross layer approach is proposed for underwater networks to increase network efficiency. Here a joint design of different network is functionalities to overcome the lack of sharing information between different layers. Underwater environment is changed due to the economic concern and an UNA have capacity to adjust itself for that environment.

The protocol design and topology should be able to self-adaptive in cause if environment changes. In the protocol design of UANs energy efficiency issue is always considered.

A) *Objectives:*

- To improve the efficiency of Vector Based Forwarding Protocol.
- To keep the network in a working state, the battery life has to be improved.
- To increase the efficiency of the network.

VI. PROPOSED METHODOLOGY

Robust, scalable and energy efficient routing are fundamental problems in underwater sensor networks (UWSNs). High latency low bandwidth, high error Probability, node float mobility is the things that differenced the UWSNs from terrestrial sensor network. There are still many challenges to the network protocol design of UWSNs.

Vector based forwarding protocol provide robust, scalability and energy efficient routing. It's a location based approach in which no state information is required on the sensor node and the packets are forwarded in interleaved path which is increase the robustness in VBF. Here we develop the self-adoption algorithm which enhances the performance of VBF.

This algorithm allows nodes to reduce energy consumption and forward packets by discarding the low benefit packets. We evaluate the results on simulations. Our results for network with medium or small node mobility (1 m/s-3 m/s), and it shows the enhancement in high success of data delivery, energy efficiency and robustness.

A) Algorithm:

Input: No. of sensor nodes

Output: Reliable path from source to destination.

Step1: Deploy a sensor network with finite no. of sensor nodes.

Step2: Check signal strength()

Step3: for(i=0;i=no. of nodes ;i++)

Step4: {

Step5: if(distance(i)>distance(i+1))

Step6: {

Step7: signal strength(i)<signal strength(i+1)

Step8: }

Step9: Else

Step10:signal strength(i)=signal strength(i+1)

Step11: }

Step12: Calculate average signal strength()

Step13: for(i=0;i=no. of nodes ;i++)

Step14: {

Step15: Average=$\sum_{x=0}^{x=n} x^n + X^n + 1$
Step16: }
Step17: if(path average(i)>path average(i+1)
Step18: {
Step19: Best path=average(i)
Step20: } End

B) Flowchart:
Step1: Create a network with finite number of nodes
Step2: Divide the network into fixed sized clusters.
Step3: Look for available path from source to destination
Step4: If path is available start communication.
Step5: Otherwise checks signal strength of each node and calculate the average strength of the node and select the nodes with maximum signal strength for communication

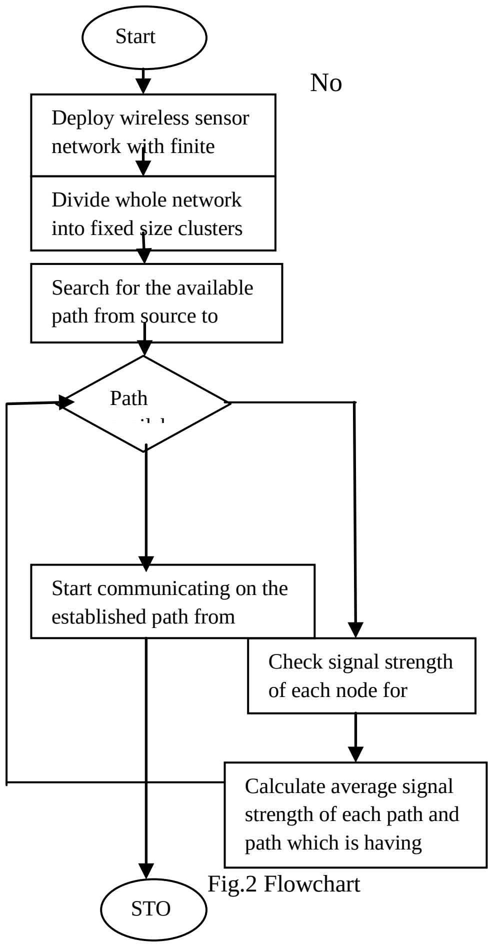

Fig.2 Flowchart

V. PERFORMANCE EVELUATION

We did simulation in NS-2 to evaluate the performance. First we implement MAC protocol and then define simulation methodology. We evaluate the effect of node mobility, node density, routing pipe radius on VBF.

A) **Implementation of MAC protocol:** VBF performance can affect by underlying MAC protocol. To evaluateits performance firstly we implement CSMA based MAC protocol which only support broadcast. It senses the channel to send packets and it use back-off algorithm in cause if channel is busy. It can use maximum 4 back-offs. This protocol has no ACK and collision detection. From our implementation we measure end-to-end delay, energy consumption and packet delivery ratio of VBF. Each sender delays its sending time to reduce the collision of packets. The data rate of MAC protocol is set to 500 kbps.

B) **Methodology:** To evaluate the performance of MAC protocol we set parameters like energy Consumption, success rate and average delay. The success ratio of packets is calculate by evaluating from the number of packets received by sink and the number of packets send but source and the actual average delay is measure by the collision detection.

C) Impact of the Routing Pipe Radius: There are 50 nodes in the network and their speed is fixed at 3m/s. We change the radius from 0 meter to 600 meters at fixed speed at 0m/s to 3m/s.

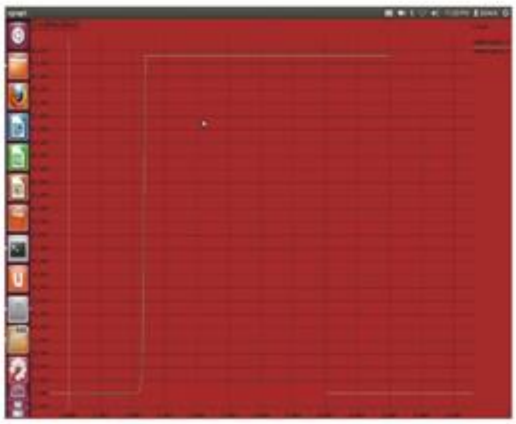

Fig.3 Throughput

Fig.3. represents the juxtaposition between the overall, old and the new throughput. And as we can clearly see that the packet delivery in the new applied technique is high right from the early start of the transmission, hence we can say that the by applying concepts of clustering, state management and node mobility. We can have an efficient underwater network.

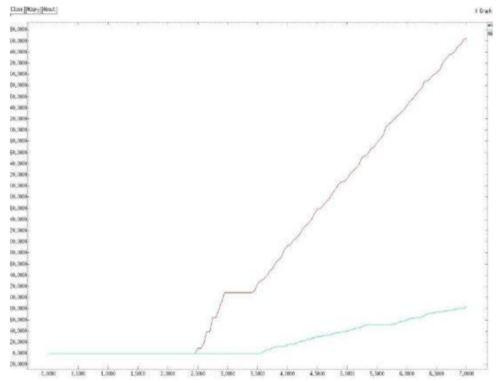

Fig.4: Energy Usage

A common presumption in case of underwater networks is that more reliability tends to imply higher energy consumption, causing difficulty in applications that require nodes to be operated underwater for long periods of time without batteries recharging, and in aquatic environments that render hard the task of recharging or replacing batteries.

Here in Figure4, we can see that without implementing the concept of VBF or node mobility the battery/energy consumption is relatively higher than that of while implementing the same. In the figure, the red line depicts the energy consumption rates without taking into concern the node mobility and the green line represents the new energy usage graph.

VI. Conclusion

Here we proposed a vector-based forwarding (VBF) protocol to address the routing challenges in UWSNs.

- It's scalable in terms of network because no state information is required at nodes.
- It's also energy efficient because only the nodes which are close to routing vector are used in data forwarding.
- For providing robustness against packet loss and node failure it uses path redundancy.

A) Future work: UWSNs have several directions for future investigation like MAC protocol is used as underlying link layer protocol which is not satisfactory choice. We can design the efficient MAC protocol for underwater sensor networks. And we can also work on high end-to-end delay, low bandwidth for congestion control and reliable data transmission.

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