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DIRECTIONAL VECTOR FORWARD FOCUSED BEAM ROUTING PROTOCOL FOR UNDERWATER SENSOR NETWORK

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ABSTRACT

Providing scalable and efficient routing services in underwater sensor networks (UWSNs) is very challenging due to the unique characteristics of UWSNs. Firstly, UWSNs often employ acoustic channels for communications because radio signals do not work well in water. Compared with radio-frequency channels, acoustic channels feature much lower bandwidths and several orders of magnitudes longer propagation delays. Secondly, UWSNs usually have very dynamic topology as sensors move passively with water currents. Some routing protocols have been proposed to address the challenging problem in UWSNs. However, most of them assume that the full-dimensional location information of all sensor nodes in a network is known in prior through a localization process, which is yet another challenging issue to be solved in UWSNs. In this paper, Directional Vector Forward Focused beam routing (DVFBR) is proposed for UWSN, where performance is compared with previous protocols. Routing in UWSN will become more dynamic with this new protocol. Later on performance of newly derived protocol found significantly efficient.

KEYWORDS:

UWSN;
Routing;
Protocol;
Sensor;
Nodes.

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1. INTRODUCTION

More than two third of the planet secured with water whose huge measures of potential have been stayed untouched. As of late as an endeavor to investigate this potential, numerous basic applications like oceanographic information accumulation, sea testing, etc. The underwater sensor network can be called a network having the core portion built underwater environment elementarily. It has found sustainability has been found in "Acoustic wave" rather than "Radio wave". Underwater sensor network research is, no doubt, a revolutionary step to explore the Ocean and break the solemn silence of the mystery of an unknown world. Conventional sensor network work in the terrestrial communication scheme. Underwater sensor network design, indeed, a complex task due to its adverse environment entirely asymmetric to the terrestrial network Nevertheless, such a challenging topic has been taken as our research object. To say frankly, the data transmission has been considered as the most decisive approach in this research owing to the substantially nondeterministic nature of the aquatic environment. In addition, various transmission overhead like salinity, Doppler shift, Channel fading, multipath effect etc. is a bar to efficient network design. Specific protocols are inevitable for acoustic communication severely. In this paper, various protocols are discussed with their properties and also well illustrated. Keeping the conveniences and inconveniences of the protocols, a new protocol has been proposed.

The research work is done for a novel purpose. The major key of any protocol that should be considered fast that is the routing and it's responsible for the revelation and maintenance of paths. The researcher of underwater sensor networks most of the case they concentrated on the case of physical issues, the routing strategies are comparatively a new area of network layer and the important task it done that is it introducing an effective routing algorithm. Decades after decades the researcher, engineers and scientists work in this field but there is not utmost protocol that fulfill are the necessities and quarry also. The underwater networks protocol now also in infancy position. In our paper we give a short review of existing major routing protocols and also the proposed popular routing protocols for the UWSNs. And also introducing the new unique robust routing technique for the protocol of UWSN. Which will be an era-changing protocol for the UWSN. People of the world main beneficiary of it. In this paper, we also give a short review of the existing protocol.

2. RELATED WORK

Even though various authors have submitted quality routing protocol papers and study papers in various territories of UWSNs, motionless possibility of the routing protocol introduced in this article is recognized from the current works in numerous perspectives [1-3]. In addition, some authors talked about analyzing the energy effectiveness [4-5] formation [6] prospective uses [7-8], the plans of network coding [9], besides numerous entrance strategies [10]. Issues such as data transmission, deployment and location in various conditions under UWSNs have been discussed in Architecture is a must for designing a robust routing protocol. Models of two dimensional and three dimensional submerged sensor system have been talked about. A survey on the present answers for medium access control, system and transport layer conventions are given and open research issues are talked about in [11]. Various elementary parts of submerged acoustic correspondence have been researched. Divers researched for the both two dimensional and three dimensional submerged sensor systems are talked about and submerged channel is portrayed. The fundamental difficulties for the improvement of effective underwater explanations of networking are detailed at all stack protocol levels level. Open research issues are also discussed and conceivable outcomes are delineated in [12]. A geographical routing technique called Focused Beam Routing [13], which requires each node to know only its own location and ultimate location of destination, is coupled with the distance-conscious collision prevention protocol that regulates access to the channel. MAC protocol of UWSN has been discussed in [14]. Some protocols are distance aware and collision avoiding of them [15] is considerable. Various protocols deal with reliability and energy efficiency described in [16-20]. Some protocols suggested that including depth sensors would enhance the possibility of efficient routing in comparatively deeper water. One of them is Depth based routing explained in [21, 22]. In various protocols [23-25], the clustering scheme of the sensor nodes has been discussed. Focused beam routing is also a widely discussed protocol for the efficiency of acoustic communication which is analyzed in [26-27].

3. ROUTING PROTOCOLS OF UWSN:

3.1: Directional Flooding-based routing (DFR):

DFR is solely designed for minimum number of nodes. Most of the existing protocols emphasize on the reliability of transmission but don't consider the link quality. Link quality assures whether the message will be transmitted or not. In [28], a new protocol has been designed considering the link quality in mind. Fig 3.1 illustrates the protocol that how it will work. There will be an intermediate node F shown in Fig 3.1 which will receive packet from source S and pass it to the sink D. The area will be determined by a BASE_ANGLE between node S and node D. In this way the rest packets will be transferred to the final sink. The angle is changeable with acoustic condition to maintain high transmission rate through hop by hop. Void problem is another issue. At least one node will be working in case of void problem in the network. The sensors know about its own position, neighbor's position and the destination. Thus the protocol works efficiently comparatively than other ones.

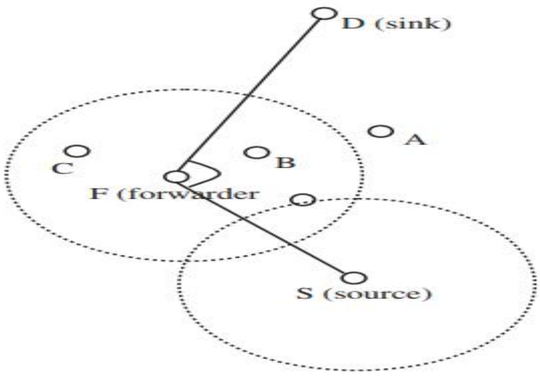


Fig 1: DFR packet transmission

3.2 Distributed underwater clustering scheme (DUCH):

In [23], a new and robust energy saving protocol is illustrated. The protocol is divided into cluster in two phases. The first phase deals with the organization of the cluster and the second phase deals with the operation of the network. The sensors are organized into a cluster centering on a cluster head. In this way, several local clusters are formed which are responsible for the collection of the local data. The cluster heads will communicate through multi hop communication to reach the sink node. Various performance issues are related with the operation of the network. Due to a disciplined framework of data transmission, the percentage of energy efficiency rises significantly. But this architecture may at risk due to environmental hazards like tsunami, seismic threat etc. However, it is considered for the energy issues basically.

3.3 Depth Based Routing (DBR):

DBR is a unique protocol which deals with depth functionalities illustrated in [23]. The sensor nodes at different depth are installed with depth sensors. The sensors in higher depth will calculate the depth of respective positions with respect to sea surface and forward data packet to comparatively lower depth sensors. While sending packet, the depth information will be put in the packet header. The whole network will transmit data in this way. But this protocol is applicable for shallow water and it may not be applicable for higher depth water. Sometimes it's seen that a node can't find a target node having lesser depth than it. Then it broadcast the data packet frequently which can collapse whole network. Though void problem is taken into account always so that such problem can't happen. There will be scopes for the development of this protocol and make it feasible in deep water.

4 Proposed Protocol: Focused beam routing (FBR):

The network can be charged with a large number of broadcast queries without early node location information, which can reduce the expected overall output. In order to reduce these unnecessary floods the Focused Beam Routing protocol has been introduced. The routing procedure assumes that each source node knows about the final destination location. In addition to this information, intermediate node need not be located. In the time of data packet traverse of its destination, rote are dynamically established and the next hop decision is taken for each step of the route after the relevant nodes have been proposed.

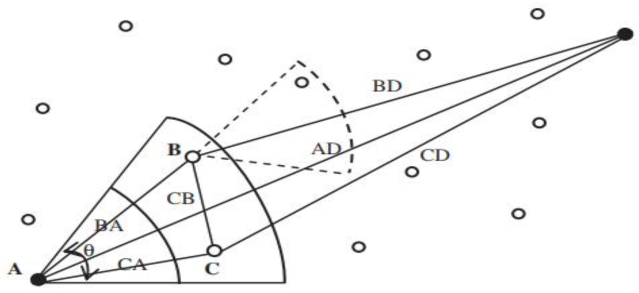


Fig. 2: FBR routing protocol illustration: the node in the transmitter cone y are candidate relays.

Fig. 2 describes the system used to transfer data to FBR. Node A has a data packet that needs to be sent to the destination node D. Node A multicast a request to send the packet (RTS) to its nearby nodes for this purpose. The RTS packet contains the location source (A) and final destination (D). Initially, the multicast action is carried out at lowest power level, which can be improved if one node is found in next hop in this communication range. They define a limited number of P1through PN power levels, which can be increased if required. All nodes that receive this RTS multicast now calculate their current location related to the AD line. When the angle is calculated, it responds to the RTS if a node determines that it is in the transmitting cone. However, the approach followed by FBR could present some problems. Firstly, if the nodes become spare due to water movement, no node may lie within the forwarding cone. Some nodes may also be available as candidates outside the forwarding area for the next hop. In this cases, if the next relay node can not be found in the transmitting cone, the RTS must be retransmitted at all time, which ultimately increases overhead communication and therefore affects data delivery in these sparse areas. Secondly, it assumes that the sink is fixed and that its location is known and that the network flexibility is reduced. To date, several protocols with their limits and conveniences have been discussed technically. In view of the constraints, a new protocol was developed to overcome them. It can be assumed that the newly derived protocol will bring about comparative improvement. The protocol is designed to keep the required communication parameters in mind so that the complexity of existing protocols can be reduced. Due to the adverse environment of underwater sensor communication, different communication parameters such as reliability, efficiency and data propagation are subject to serious malfunctions. Underwater communication is not as smooth as terrestrial communication.

5. SIMULATION AND RESULTS

5.1 Experimental Setup

For the simulation of the proposed method, Network Simulator Version 3 (ns-3) is been used. Ns-3 is a discrete-event network simulator, targeted primarily for research and educational use. Ns-3 is free software, licensed under the GNU GPLv2 license, and is publicly available for research, development, and use. The ns-3 project is committed to building a solid simulation core that is well documented, easy to use and debug, and that caters to the needs of the entire simulation workflow, from simulation configuration to trace collection and analysis. Furthermore, the ns-3 software infrastructure encourages the development of simulation models which are sufficiently realistic to allow ns-3 to be used as a real-time network emulator, interconnected with the real world and which allows many existing real-world protocol implementations to be reused within ns-3. The ns-3 simulation core supports research on both IP and non-IP based networks. However, the large majority of its users focuses on wireless/IP simulations which involve models for Wi-Fi, WiMAX, or LTE for layers 1 and 2 and a variety of static or dynamic routing protocols such as OLSR and AODV for IP-based applications. Ns-3 also supports a real-time scheduler that facilitates a number of “simulation-in-the-loop” use cases for interacting with real systems. For instance, users can emit and receive ns-3-generated packets on real network devices, and ns-3 can serve as an interconnection framework to add link effects between virtual machines.

Fig.3 shows the experimental setup which is designed in ns-3. In this figure the red color node is the surface sink node, blue color nodes are the surface buoy and green color nodes are the underwater sensor node. Two scenario is designed between them one is applied with the proposed routing protocol and another is configured with Depth based routing (DBR).

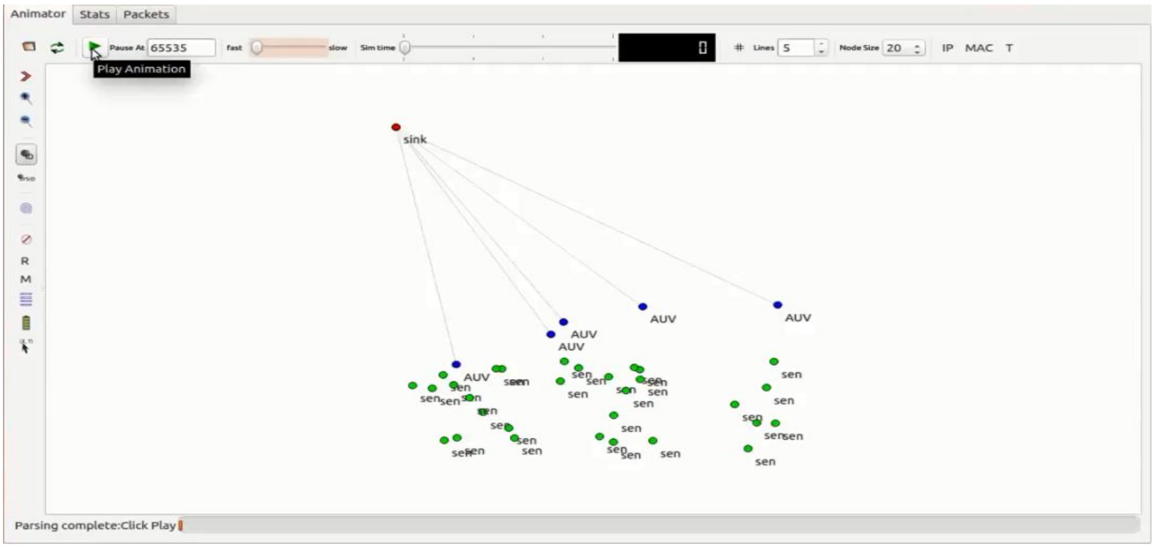
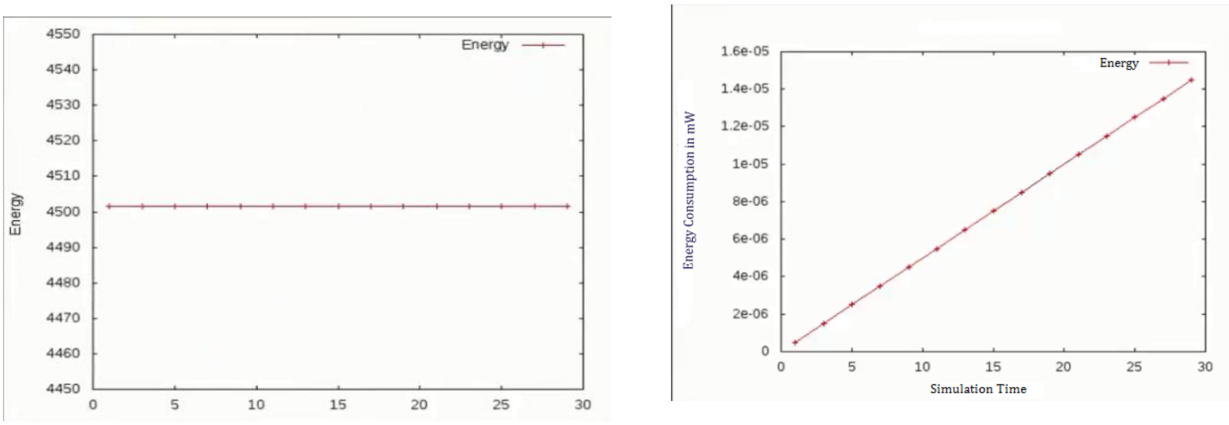


Fig. 3: Experimental Setup

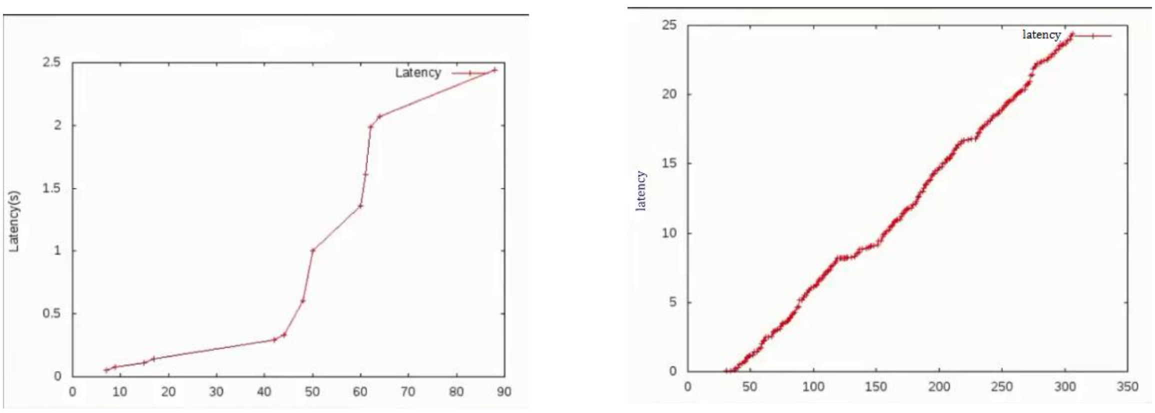
The energy consumption graph of proposed method and DBR method is illustrated in figure 4.2. The X-axis of the graph denotes the simulation time and Y-axis of the graph denotes energy consumption in mW. After observing the graph it is seen that in the proposed method there is no change of energy consumption compared the conventional DBR method.



(a) Energy Consumption (Proposed) (b) Energy Consumption (DBR)

Fig. 4: Energy Consumption Comparison graph

Latency of the UWSN is illustrated in Figure 4. Both proposed and DBR based method is applied to calculate the latency. The X-axis describes the simulation time and Y-axis of the graph describes latency in second. At the simulation time 90, the latency in proposed method is 2.5s whereas in DBF method the value is almost double 5s. The proposed method converge the network comparatively faster than DBF method.



(a) Latency in S (Proposed) (b) Latency in S (DBR)

Fig. 5: Latency Comparison graph

Here we give a comparison table which we compare our protocol with some existing new protocol. When we compare the protocols, we take some major parameters that are the delivery ratio, delivery efficiency, energy efficiency, bandwidth efficiency, reliability, cost efficiency, and finally the performance. And obviously we compare with that protocol which is related to our protocol. The protocol chosen for the comparison that are the vector based forwarding, focused beam routing, reliable and energy balanced routing algorithm, information carrying routing protocol, directional flood based routing protocol, distributed underwater clustering scheme depth base routing , and finally we give the result which we find after the simulation . And we said that it is a robust routing protocol.

Table 1 Parameters Comparison

Protocol/architecture	**Delivery Ratio**	**Delay efficiency**	**Energy efficiency**	**Bandwidth efficiency**	**Reliability**	**Cost efficiency**	**Performance**
Vector based forwarding	Low	Low	Fair	Fair	Low	Not applicable	Low
Directional flood-based routing	Fair	Fair	Low	Fair	High	N/A	Fair
Depth based routing	High	High	Low	Fair	High	Fair	High
Directional vector based forward focused beam routing	Very High	Very High	High	Fair	High	N/A	High

6. CONCLUSION

Both in terrestrial and underwater network system routing is an important issue. A short overview given in this paper on under water sensor networks. Routing system in underwater network is very important because every parameter and their performances somehow connected with the routing protocol. Here in this paper we give a vigorous drive on routing protocol of UWSNs. The routing protocol which is related to our protocol that are analyzed anxiously their merits, demerits. In addition we compare protocol energy efficiency, latency etc. In underwater wireless sensor networks still there are huge scope of work on it because many research challenges are yet not solved. Therefore, the scope of future work should be performed in order to superintend that the available solutions in greater detailed.

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