International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 05 | May 2019 www.irjet.net p-ISSN: 2395-0072

Energy Efficient Underwater Routing Protocol with Void Avoidance and Bypassing Capability

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Abstract: *An underwater sensor network is one of the latest technologies used mainly for the development of the routing protocols below water. Due to the presence of void nodes and the trapped nodes, the delivery of the packets from source to the final destination which is assumed on the surface is a critical issue in which this technology is facing. In this paper, we come across a pressure routing protocol which is aware of voids in the communication area and is known as the void aware pressure routing protocol (VAPR). It collects the data related to aquatic information and guarantees the delivery of the packets to the surface even in the presence of nodes. The void node is determined based on the depth of the neighbor nodes and keeps the information such as sequence number, hop count, direction of the packet etc. As, the energy efficient protocol which uses different control packets to detect the void nodes and trapped nodes and has some issues like traffic and jammers etc. Beaconing are initiated by the sink is a void handling technique used for VAPR. Here all nodes are aware of depth using a pressure gauge without the need of path recovery. Simulation indicates the performance of this particular protocol.*

Key Words: Pressure Routing, VAPR, Under Water, Sensor

Ⅰ. Introduction:

Underwater wireless sensor network is defined as the way of carrying a particular task of sending and receiving the messages below water in a scientific approach. As we know that this trending technology has come up with many wide resources which are very much helpful for human benefit through the nature from the birth or the evolution of water resources in the form of oceans, rivers, ponds, lakes and canals. Among the nine planets in the solar system, the planet called as earth is 75% of it is covered by the huge amount of water resources. That is why planet earth is called as the water planet [2]. Generally, there are two types of communications and they are underwater communication and terrestrial communication [1]. In Underwater communication, the sensor nodes play a vital role in transmitting and receiving the signals and they are deployed below water to perform some water related work like monitoring and collecting the information available in the ocean from the source node and transmitting that information to the surface in which acoustic signals are used which has the speed of 1500m/s and then that information is carried to remote stations which is a terrestrial communication uses radio signals at the same speed of light .

As sensor nodes are deployed below the water to perform the task related to water properties like quality of water, temperature and pressures same like sensor nodes some autonomous vehicles are also present. On the whole there are several ways of employing such type of communication, but the most common type of communication is by using hydrophones. Most of the hydrophones are based on piezoelectric transducer that generates an electric potential when subjected to a pressure change such as a sound wave. Apart from this there are some of the factors that are the main issues in case of underwater networks like limited bandwidth, high propagation delay and many more. Therefore, research work is carried out for such issues.

Ⅱ View on VAPR:

This protocol is a void aware pressure routing protocol, in which nodes are aware of depth information using a pressure gauge. It has the advantage of the possibility of encountering the void area during forwarding of packets using local maxima which has information of the present status of the node [6]. Any cast model is used because it is a multi-sink architecture, suitable for large networks, guarantees packet delivery, void is determined and is more available paths from source to sink. Any cast model comes under pressure based where DCR, GR+DTC, Hydro cast, VAPR and WDFAD-DBR protocols comes under depth based void handling techniques[8]. The directional forwarding is shown in the figure where it does not impose extra cost to use void recovery technique as it propagates surface reachability information and is also loop free in dynamic environment.

Table 1: Comparison of different routing protocols

The characteristics of the void aware pressure routing protocol is compared in the above figure. The void handling technique of this protocol is based on beacons which gives warning signals and is initiated by the sinks itself. It has preventative activeness where it does not need large number of control packets for the path. VAPR is based on opportunistic forwarding as it removes hidden nodes from their forwarding and therefore has no duplicated packets. VAPR is a soft state because they rely on beaconing information useful for routing efficiency; it maintains surface reachability information rather than maintaining a path towards the sink [3]. VAPR are able to bypass all kinds of nodes using reachability information. Therefore, it guarantees a packet delivery. Optimality of path is nearly optimal where a straight line between source and sink, shows the distance traversed by a packet is close to the optimal path expressed in length. It has low latency by packet forwarding. Communication overhead is medium when handling a void. They are scalable but not as other routing protocols. Energy efficiency is high because they use the opportunistic packet forwarding which addresses the hidden terminal problem.

Ⅲ. Directional forwarding of data in VAPR: VAPR handles the problem of void nodes only because of opportunistic directional data forwarding and enhanced beaconing. A beacon consists of sequence numbers, hop count in terms of up and down direction in order to reach the closest sink surface. The whole network is based on periodic beaconing and also it keeps the additional information to handle the voids. The packets should be traversed in vertical direction and not in horizontal direction. The data forwarding direction is correct in determining the route. Forwarding node consists of neighboring nodes with a change in direction of the route. As node b receives a packet from node, its data forwarding direction and next hop are equal [4]. It only sends the packet to node a as it is in shallower depth and it matches based on next hop and data forwarding direction set as up. Therefore, node x is trapped node filtered by node b and is set to down as shown in figure.

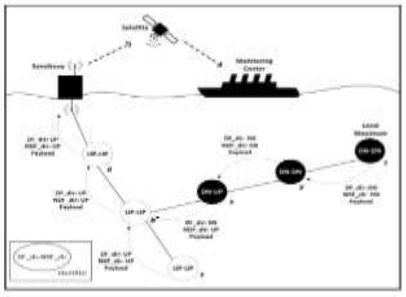

Fig 1: Directional data forwarding

Ⅵ. Simulations:

Experimental results:

A. Energy consumption:

Energy consumption per message is a graph plotted against number of nodes and the energy per node per message. It also consists 64 sonbuoys. Here the depth based routing protocol consumes less amount of energy compared to other protocols in the graph [7].

DBRs failure of redundant packet suppresses causes excessive packet collisions. As a result, DBR consumes more energy than other protocols. Hydro cast does not require a route recovery process. It performs consequent beacons similar to VAPR. HBR performance does not increase that of hydro cast as the number of deployment nodes increases due to absence of opportunistic forwarding.

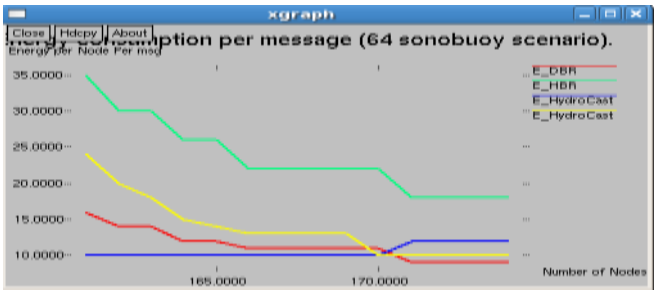

Fig 2: Energy consumption per message

B. Packet delivery ratio (PDR):

The graph here is packet delivery ratio is more in depth based routing protocol because it consists of an energy efficient protocol which excludes all the routes leading a trapped or void node and giving more chance to packet

delivery to the regular nodes as shown in the graph where it is defined as the ratio of number of packets successfully received by the sink nodes to number of packets sent by the source node [5]. Examines the packet delivery ratio of DBR, HBR, hydro cast and DBR with 1 sonobuoy on the surface. The packet delivery ratio of HBR outperforms those of rest greedy forwarding protocol namely, DBR and hydro cast. The number of nodes increases, the packet delivery ratio does not increase proportionally due to increase in number of retransmissions.

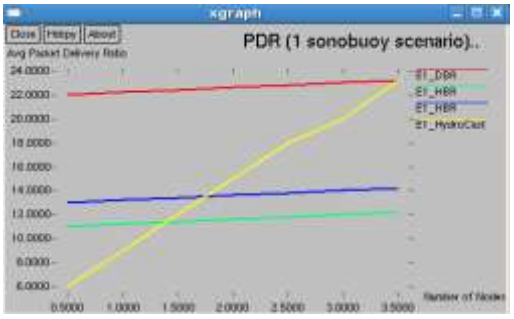

Fig 3: PDR

C. Different beacon intervals on energy consumption:

This is the graph which gives the different beacon intervals on energy consumption. Generally, the beacons give the signals by guiding and warning them. Therefore, depth based routing protocols has different beacons which are increased on energy consumption.

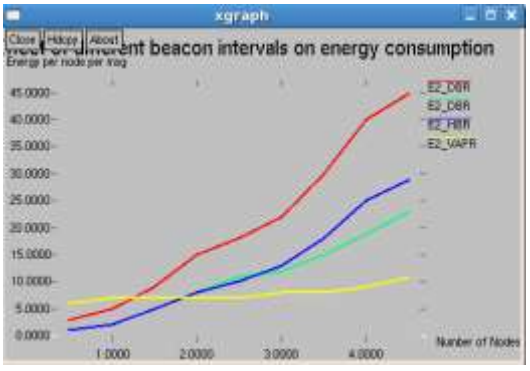

Fig 4: Different beacon intervals on energy consumption

V. Conclusion:

In this VAPR pressure routing protocol is used which is energy efficient, robust and delivers the packets from source to the surface even in the presence of voids. It uses enhanced beaconing and the opportunistic data directional forwarding for the nodes mobility in the underwater communication using acoustic signals.

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