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Simulation of Adaptive Acoustic Modem using ns2: Enhanced Forward Aware Factor-Energy Balanced Routing Method

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***Abstract*— *An adaptive acoustic modem is to be designed to achieve communication in different frequencies. As modem is adaptive, receiving of signal at different data rates is also possible. But, in underwater acoustic communication only acoustic waves would be the better option. Acoustic waves can be detected under the water. An acoustic modem is used in different applications such as disaster prevention & information exchange. A network can also establish among the underwater sensors the important advantage of using this method is to balances the energy consumption of nodes and increases the function life time (FL) This network helps to communicate surface sub stations and sensors.*

***Keywords*— *Acoustic waves, EFAF-EBRM, forward transmission area, WSN.*

I. Introduction

In underwater communication, networks often rely on acoustic communication. As electromagnetic waves propagate poorly in sea water, acoustics provides the most preferred medium to enable underwater communication. But, it is having too many issues in data transmission. The issues are like environmental factors & location problems. So, in order to ensure efficient & reliable transmission, an adaptive modem for acoustic communication should be designed which changes according to parameters.

Underwater communication is exactly meant by long term monitoring of data. It follows procedure of deploying oceanographic sensors, recording the data & recovering the instruments. It may produce lag in output at receiver. The better results can be achieved by establishing real-time communication between instrumental & control centre. Underwater Acoustic Networks (UANs) are very unique and can be used for commercial and military applications. Some of the broad applications of UANs are such as Information exchange, surveillance, targeting, and disaster prevention.

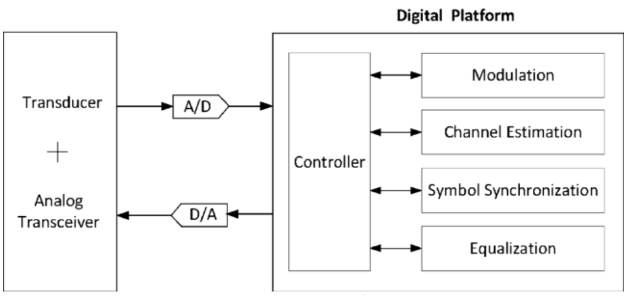

Fig. 1. Block diagram of modem [1].

WSN`s are deployed to monitor the sensing field and collect information from physical or environmental condition. These sensors co-operatively pass the collected data through the network to a main location. Due to the limited energy and communication limitation of sensor nodes, it seems especially important to design an energy efficient routing protocol for WSNs. Energy consumption is an important factor in the architecture designs of WSNs.

II. Methodology

Design

Underwater acoustic modem consists of three fundamental components as shown in figure 1 a transducer, an analog transceiver and a digital hardware platform for signal processing and control.

Controller

The controller operates the digital platform. This includes moving data to and from the analog transceiver, setting the parameters for the various parts of the digital hardware, and ultimately interfacing with higher level network stack.

Modulation

There are many different types of signals used for underwater communication. These include FSK, PSK, orthogonal frequency direct modulation (OFDM), and DSSS. While an adaptive modem can ideally switch between any modulation scheme.

Channel Estimation

A major component of an adaptive modem is the ability to change aspects of the modem including selecting a modulation scheme, the data rate, the transmit power, and other configurable portions of the design. Many of these depend upon current and future characteristics of the acoustic channel.

Receiver Algorithms

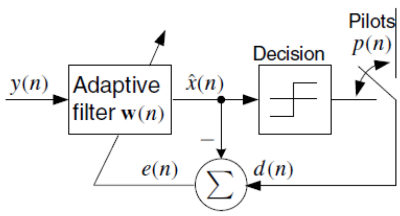

Fig. 2. Adaptive equalization.

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The receiver algorithms for payload detection include adaptive channel estimation and channel equalization. Although UWA channels are very long, field measurements show that the channels are often very sparse with most energy of the channel impulse respond concentrated on a few taps and most taps submerged by noises. Rather than using the normalized least-mean-square (NLMS) algorithm, we adopt the improved proportionate NLMS (IPNLMS) algorithm for the adaptive estimator and equalizer, as shown in Figure 8. By utilizing the sparse nature of underwater acoustic channels, the IPNLMS method can track the time-varying frequency selective channels, as detailed in. To adapt the equalizer coefficients, zero forcing (ZF) equalization is adopted as te first version of the implementation. The advantage of ZF equalization is its low computation complexity [5]

III. SOFTWARE IMPLEMENTATION

Dual Cluster Implementation

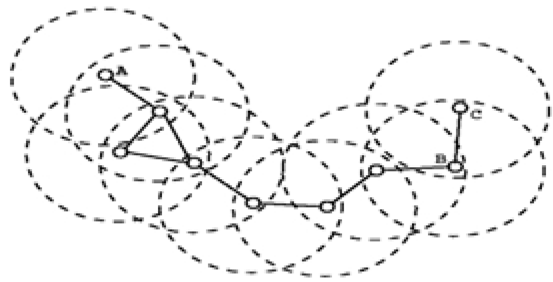
Enhanced forward aware factor-energy balanced routing method

In this module we propose an Enhanced Forward Aware Factor-Energy Balanced Routing Method (EFAF-EBRM) based on Data aggregation technique that has some key aspects such as a reduced number of messages for setting up a routing tree, maximized number of overlapping routes, high aggregation rate, and reliable data aggregation and transmission. According to data transmission mechanism of WSN, we quantify the forward transmission area, define forward energy density which constitutes forward-aware factor with link weight. For energy efficient transmission in event-driven WSN, Data should be reduced. It requires proper routing method for reliable transmission of aggregated data to sink from the source nodes. This paper propose a new communication protocol based on forward-aware factor in order to determine next-hop node and Data Routing for In-Network aggregation(DRINA) protocol to reduce the number of transmissions and thus balancing the energy consumption , prolonging the network function lifetime and to improve QoS of WSN.

The routing algorithm can be divided into seven stages as follows.

Initially we are placing nodes in the network and we choose a source and destination. If the source has no route to the destination, then source A initiates the route discovery in an on-demand fashion. After generating RREQ, node looks up its own neighbor table to find if it has any closer neighbor node toward the destination node. If a closer neighbor node is available, the RREQ packet is forwarded to that node. If no closer neighbor node is the RREQ packet is flooded to all neighbor nodes. When destinations receive the RREQ, it will generate RREP and it will send the same path. Finally we establish the route for data traffic.

Determine and all of the possible next-hop nodes of node. First, take as the communication radius, determine the set of all of the nodes that have edges with. Select the nodes that closer to Sink than does, which constitute the set of all of the possible next-hop nodes and the furthest node determine.



Determine and of each possible next-hop node. Determine as we determined. Plug the furthest distance between and nodes in FTA and the distance between and *Sink* into and obtain.

$$\text{Distance} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Calculate of each possible next-hop node. Plug all of the nodes' energy into and get. Calculate the weight of edges between and each nodes according to.

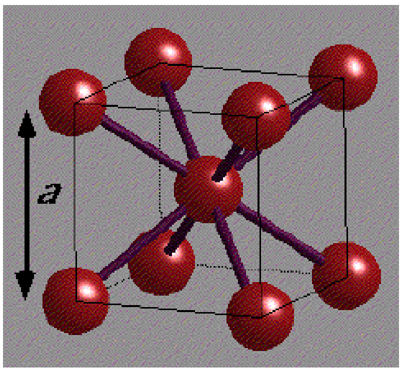


Fig. 4. Cluster with cell edges.

Usually, the length of the cell edge is represented by *a*. The direction from a corner of a cube to the farthest corner is called body diagonal (*bd*). The face diagonal (*fd*) is a line drawn from one vertex to the opposite corner of the same face. If the edge is *a*, then we have:

$$fd^2 = a^2 + a^2 = 2\,a^2$$

$$bd^2 = fd^2 + a^2$$

$$= a^2 + a^2 + a^2$$

$$= 3\,a^2$$

Atoms along the body diagonal (*bd*) touch each other. Thus, the body diagonal has a length that is four times the radius of the atom, *R*.

$$Bd = 4\,R$$

The relationship between *a* and *R* can be worked out by the Pythagorean theorem:

$$(4\,R)^2 = 3\,a^2$$

Thus,

$$4\,R = \text{sqrt}(3)\,a$$

Or

$$a = 4/\text{sqrt}(3)\,R$$

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Recognizing these relationships enable you to calculate parameters for this type of crystal. For example, one of the parameter is the packing fraction, the fraction of volume occupied by the spheres in the structure.

Plug the parameters of 3 and 4 and calculate FAF of each possible transmit link. Choose the next-hope Node.

Determines the angle of a straight line drawn between point one and two. The number returned, which is a double in degrees, tells us how much we have to rotate a horizontal line clockwise for it to match the line between the two points.

If you prefer to deal with angles using radians instead of degrees, just change the last line to:

"return atan2(yDiff, xDiff)" */ from math import atan2,degreesdef GetAngleOfLineBetweenTwoPoints(p1, p2): xDiff = p2.x - p1.x yDiff = p2.y - p1.y return degrees(atan2(yDiff, xDiff))

If there is no node closer to Sink than in , directly compare FAF of all of the nodes in , and choose the next-hop node. If there is no node in will increase the transmit power to get a longer radius than until connected with another node, or will abandon the packet.

Sensor node sends a data to CH, CH will validate the sensor's data with neighbour's data, if any sensor node's data is not related to remaining node's data. It will allocate a high threshold profile value to the particular sensor. Based on the scenario all the nodes collect the profiles.

After collecting the profiles, CH validate the profile values, if any sensor get high profile threshold value. That sensor caused by false data injection. So CH will eliminate the sensor node from a network.

Finally CH aggregates all the data and it will forward the data to corresponding sink node. This process will continue till network life time. If Sink is among the forward transmit nodes, will transmit data directly to *Sink* and accomplish the procedure. In FAF-EBRM, the routing list structure of nodes. The information of the table can guarantee all the parameters FAF-EBRM algorithm needed. The communication launch node can calculate the weight of edge between neighbors. Neighbors can get its own FED. It avoids the communication launch node doing all of the algorithms. Thus, each node's memory should storage its own ID, real time energy, distance to the Sink, and FED at any moment, which could be feedback to launch node quickly.

In following figure, Cluster will be formed as per availability of nearest master node & routing protocol specifications,

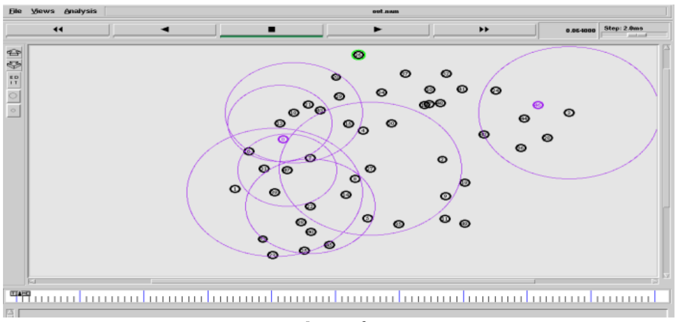

Fig. 5. Cluster formation.

Sensor nodes are randomly dispersed in the rectangular sensing field. Data are sent to the cluster head and then from cluster head to sink node. Figure 6 shows the distribution of node in the rectangular W×H field. In this network model, all nodes are similar i.e isomorphic; they have restricted energy and communication ability.

In real time, there will be number of clusters in networks. But, best route will be selected for transmission & data aggregation from cluster head.

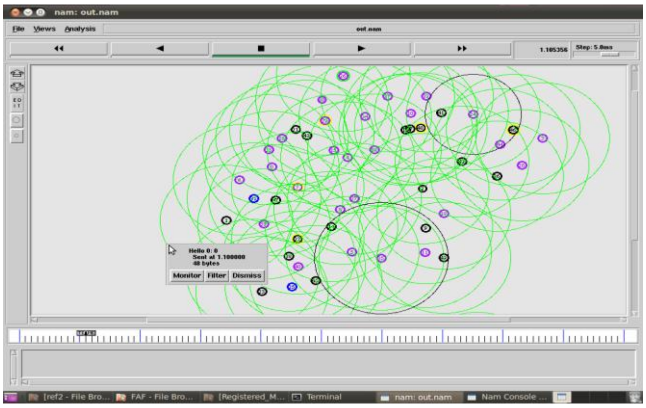

Fig. 6. Output overview.

In WSN clustered hierarchical routing protocol, sometimes cluster members in a cluster may be nearer to the sink than the CH, should transmit data to CH first. It results backward transmission of data and leads to waste of energy.

In this method, an energy-balanced routing protocol is designed that uses forward transmission area (FTA) based on position of sink and final data flow direction. In other words, FTA define forward energy density which constitutes forward-aware factor with link weight. Here we propose a new communication protocol based on forward-aware factor, to balance the energy consumption and prolonging the network function lifetime.In FAF-EBRM, every time node i finishes transmission, and then the point strength of the next-hop node j is checked. If it is less than average value of all of the sensors strengths in FTA, the local topology reconfiguration mechanism should be launched in node i's FTA This project was done using NS2. Basically NS2 program contain four steps. They are 1). Create an event scheduler 2). Turn on tracing 3). Create a network 4). Monitor using network animator. Creating network contains computing the setup routing, creating transport connection and creating traffic.

IV. CONCLUSION

This paper concludes that modem for underwater network can be established. Enhanced Forward Aware Factor-Energy Balanced Routing Method offers better data aggregation and transmission. Underwater sensors can communicate in some better aspect than earlier.

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