

can achieve priority to be sent. The node which have a larger value of TDM than other nodes have high priority to achieve channel.

- iv) Competition waiting: Receiver only communicates with only one contender in each communication. Other failed contenders continue to contend the channel after this communication ends. We propose a dynamic competition waiting mechanism in order to satisfy fairness of channel competition and reduce collisions.

Algorithm 1 Packet Insert

Require: *New_packet*, **Queue*

Begin function

```

1:   td_new = time_distance(New_packet);
2:   if (td_new ≥ max_td) then
3:     free(New_packet);
4:   else
5:     node *s;
6:     s = (node*)malloc(sizeof(node));
7:     s -> packet = New_packet;
8:     s -> next = NULL;
9:     if (Queue -> rear == NULL) then
10:    Queue -> first = s;
11:    Queue -> rear = s;
12:   else
13:    Queue -> rear -> next = s;
14:    Queue -> rear = s;
15:   end if
16:   Update_Sort(Queue);
17:   end if
18:   return(Queue);
    
```

End function

Thus in case of network congestion, delaying a period time dynamically is helpful to compete for channel, avoid data collisions effectively and raise network performance and the success rate of data transmission.

When run nam out.nam, the animator will open. Here it is showing the nodes placed in respective positions. This is the initial phase where it shows the position of the nodes in the network that intends to participate in the transmission.

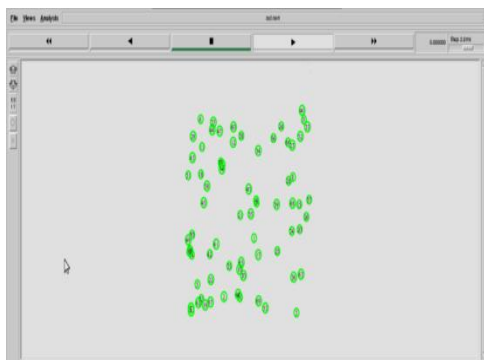


Figure 1 : NS2 interface showing initial position of the nodes

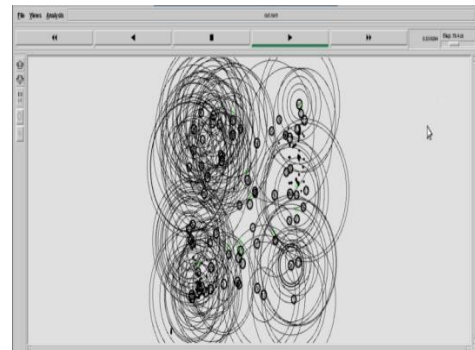


Figure 2 : NS2 simulation representing the transmission of the packets

In the above figure, it shows transmission of packets from source to the destination and also focuses on the queue management.

The below graph which are obtained by the simulation summarizes that the delay is eventually reduced though the traffic rate is increased. Thus attaining the goal of reduced propagation delay by using the Time Distance Metric for transmission of the packets from source to the sink. Due to the decrease of the delay we attain the increased or efficient utilization of the energy along with increased throughput. Thus our experiments have proven that we attain a better network performance in underwater sensor networks.

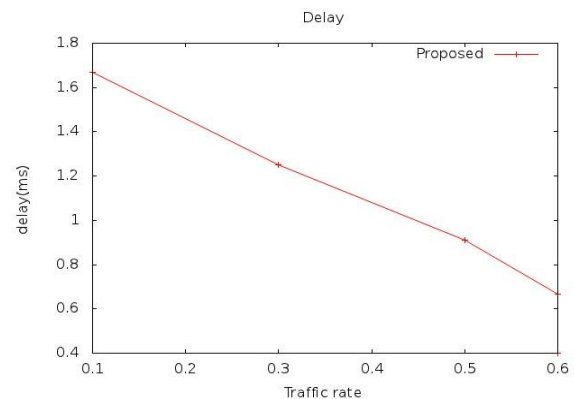


Figure : Representing graph of delay vs traffic rate

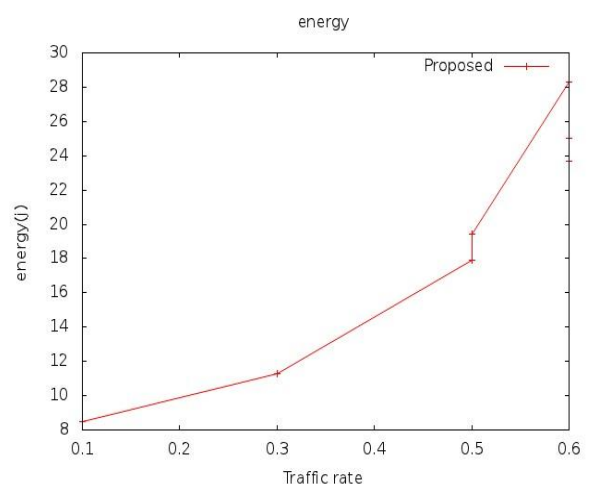


Figure: Representing graph of energy vs traffic rate

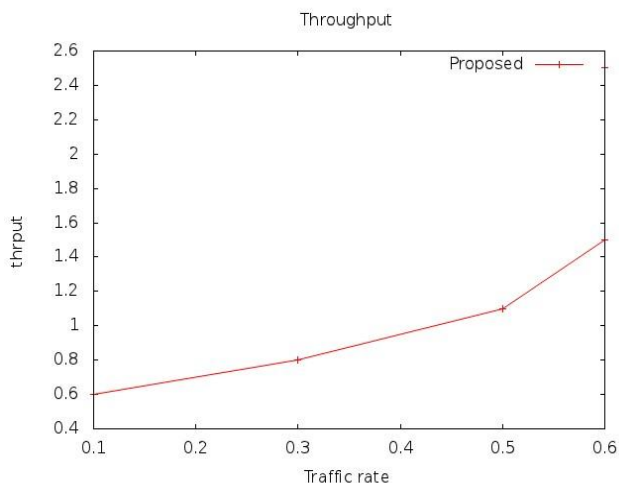


Figure : Representing graph of throughput vs traffic rate

6. Conclusion and Future Work

We have proposed time synchronized fair data transmission in secure UWSNs that ensures security of synchronization under harsh underwater environments against various attacks, including Sybil attack, replay attack, message manipulation attack, and delay attack. The time synchronization process ensures that all nodes are well synchronized thus delay can be minimized and the energy loss due to the delay can be reduced. We demonstrate through simulations that fair data transmission implemented along with time synchronization. Fair data transmission includes queue management, transmission control and competition waiting. This will mainly use Time Distance Metrics, which is a metrics used to allocate channel for the transmission, to place the packets in the queue. This assures reduce the number of sending control packets and its collision probability, decrease energy consumption and prolong the network lifetime. Simulation results show that when the network load is heavier, we can effectively improve the fairness of data transmission and the success rate of delivery, and reduce end-to-end delay, the average energy consumption and increased throughput. In future work, we will investigate the influence of MAC layer activities to the performance of time synchronization protocols, such as packet loss and retransmission. Moreover, we will perform the analysis of the adaptability of our strategy and evaluate its performance through real ocean experiments.

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