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Enhancing QoS in WSN using Hybrid Optimal Hop-Alert Routing Algorithm (HORA)

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ABSTRACT

Wireless sensor networks have wide usage in real-time applications but it has some problems while designing routing algorithm especially delay and high bandwidth. To achieve better performance in ESN we propose hybrid optimal hop-alert routing algorithm (HORA) in our work. The aim of our algorithm is to find the optimal path to transfer data. Here the proposed algorithm is compared with existing algorithms LBORF and EEAR.

Keywords: Wireless sensor networks, Location aware routing, Quality of service (QoS), Energy efficiency and Optimal path.

1. INTRODUCTION

Wireless sensor networks (WSNs) contain numerous sensor nodes which receive the data and transfer to the sink. This communication between nodes is done by the links in it. Each node is built with four units, they are: processing unit, energy unit, sensor unit and communication unit [1]. The communication between nodes is not always perfect so it is important to use routing algorithm to transfer data from source to sink. But this process may consume time and the data also put in queue manner to avoid congestion. If the path is not predefined it may results in delay even the source is single [2]. This leads to wastage of energy which then reduce the network lifetime. Some sensor network applications such as intruder detection, medical care, awareness of the fire, nuclear reactor control and identify health, have real-time requirements for the data. A network is meant to be good when packet delivery is perfect. The data has to be transferred without any delay for real-time applications especially in healthcare. The data is valid only for limited duration after that it cannot be sed. This duration can vary depends on applications. Quality of service (QoS) is defined as the service requirement of each application in the network [3].

Throughput, delay, jitter and packet loss rate are the parameters of QoS. Apart from this reliability, timeliness, robust, availability, security are also important. The above mentioned parameters are used to measure the degree of satisfaction. The need of this QoS is varied for different environment. It is a tedious task to reduce the traffic and achieve better QoS in all topology of networks.

While designing the protocols and algorithms for wireless sensor networks facing many problem in research area in terms of energy utilization so that network lifetime can be increased. Apart from lifetime many parameter such as latency, throughput, packet loss are taken into consideration [4]. Depending upon the applications delay may occur during data transfer between sensor nodes. The reliability of data also important but it is affected by the practical attributes ex., temperature sensor nodes are not sensing and forwarding the data to the sink at time intervals Another example is forest fire detection which follows the above mentioned process. As an advanced applications the multimedia sensor nodes are used to overcome the throughput and delay limitations at crucial times [5]. QoS (Quality of service) depends upon bandwidth and energy consumption in the network. So we have to aware about usage in QoS in various applications with different layer of protocol stack. This results in efficient accessing of sensor readings[6]. Therefore, enabling many applications in sensor networks requires energy and QoS awareness in different layers of the protocol stack in order to have efficient utilization of the network resources and effective access to sensors readings. Thus QoS routing is an important topic in sensor networks research, and it has been under the focus of the research community of WSNs.

The rest of the paper is organized as, Section 2 discusses the related work and the proposed mechanism is presented in Section 3. The performance analysis of the proposed protocol and its comparison with a few similar protocols is shown via simulation in Section 4. Finally, the conclusion is presented in Section 5.

2. LITERATURE SURVEY

Chenyang Lu et al. [7] proposed a Real-time Architecture and Protocols (RAP) which is based on velocity [that leads to give better service by classifying the packets and transferring in time allocating with domain based strategy X.Hunag and Y.Fang considered Qos requirements (i.e.,) delay and reliability have proposed Multi Constrained by designed an algorithm named Multi Path (MCMP) routing protocol [8]. The author mainly concentrated on optimization problem and created a method to solve that. The method is named as linear programming. According to this algorithm multipath is created to transfer the packets with minimum number of hops. This minimum number of hops leads to less energy consumption [8].

Z.Lei et al. developed extension of SPEED protocol named as FT-SPEED [9] whereas it avoids the routing problems during the transmission of data from source to destination. Foh et al. in [10] calculated successive hop lengths for reactive algorithms. According to this algorithm, when number of hops increases the data forwarding nodes becomes periphery for broadcasting purpose. Conditional Max-Min battery capacity routing algorithm proposed find the minimum power in case the nodes having same battery capacity. Based on that power the route is selected. In case the route is reached the remaining power can be neglected [11].

CEDAR, is proposed by Sivakumar et al,. [12] especially for medium sized adhoc networks that consist of hundred number of nodes in it. Core extracted distributed adhoc routing algorithm is designed in a way that automatically incremented and propagates through the link that has high stabled bandwidth. Here the route is created based on demand based method using local conditions. In [13] the author proposed a Hop-based Energy Aware Routing (HEAR) algorithm which can largely reduce energy consumption as well as prolong network lifetime. However, the hotspot problem cannot be avoided since we try to minimize the total energy consumption during certain route rather than to let sensor nodes consume their energy at similar rate. In [14] energy aware dual-path routing is proposed for real time traffic by Mahapatra et al.,. In this scheme, the process of routing takes into consideration packet deadline, energy of the forwarding nodes and congestion at intermediate nodes. By ways of periodic beacon message exchange with neighbours, each node maintain a neighbour table that contains the geographic location of a neighbouring node, the energy left, the estimated time delay and the mobility factor. To increase reliability, data packets are duplicated at the source node. Through simulation authors show an improvement in performance for high traffic real-time packets as compared to other geographic routing scheme.

3. RESEARCH METHODOLOGY

According to our proposed routing algorithm, four phases should be followed: Zone partitioning, updating the tables, Route discovery process, Optimal path finding. Many routing algorithms are quite flexible in terms of wireless area network, but it is not able to provide support for energy awareness and requires a best path for a communication among the nodes in network. The wireless channels are unstable, there is no assurance for data deliverance from sensors to the sink. It leads to data loss, wastage of energy and also decreases the total data collected by the sink and increase the overall energy utilization by the sensors. So it is important to find the best path which is achieved by our proposed Hybrid Optimal hop-alert Routing Algorithm (HORA).

A. Zone partitioning

We dynamically partition a network field into zones and randomly chooses nodes in zones as intermediate relay nodes, which form a non traceable anonymous route. Specifically, in each routing step, a data sender or forwarder partitions the network field in order to separate itself and the destination into two zones. In the last step, the data is broadcasted to k nodes in the destination zone, providing k-anonymity to the destination. A sensor in each zone has a probability p of becoming a CH during each round. The probability p is determined relative to the number of nodes in the zone: p = 1/(number of nodes in zone). Zone partitioning divides the sensor field into z equal zones. Equal zones were chosen because the distribution of nodes is uniform in the field**.** we assume the entire network area is generally a square shaped and the information of the bottom-right and upper left boundary of the network area is configured into each node when it joins in the system.

B. Table updating

One entry in the inter-zone routing table, denoted InterZoneRT, contains the destination zone (destZoneId), the next zone (nextZoneId) and the zone metric (zoneM). The packets exchanged in this table-construction phase contain the following information: the source node (srcId), the next hop (nextHopId), the zone of the source node (srcZoneId), the subject (which may be COMPL TABLE: complete the table or UPDATE TABLE: update the table), the zone table (InterZoneRT) and the final destination (finalDestId). When receiving a routing control packet packet, a node processes it depending on its type (NORMAL, BORDER or BORDER-CHIEF). A normal node forwards the packet towards the final destination; a chief node updates the InterZoneRT routing table and sends updates to some border nodes of its zone and to the border nodes of the neighboring zones. Finally, a border node forwards the packet to the chief node of its zone, if the packet comes from a border node of a neighboring zone. Otherwise, if the border node is a final destination, either it updates the table, or it forwards the packet to the border nodes of the neighboring zones; else, it sends the packet to the final destination.

C. Route discovery

A source initiates route discovery in the same manner as in AODV. However, after it transmits an RREQ, it also sends an additional RREQ ALERT packet. This is sent at the MAC layer after a Short Inter Frame Space (SIFS) duration following the transmission of the RREQ and is transmitted at a lower transmission power to cover fewer nodes which are closer to the source. We refer to the coverage area of the alert packet as *Alert Range (AR)* and that of the route request as *Request Range (RR)*. Intuitively, $AR \leq RR$ with $AR = RR$ in pure AODV.

However, in Hop Alert, any node within the *AR*, on receiving the RREQ ALERT, would defer broadcasting for a duration large enough for it to hear a rebroadcast from any other node within its range. This duration is predetermined in the implementation of the algorithm and kept constant across all nodes. If, during this duration, it receives another copy of the same RREQ, it drops its own copy of the packet. This would imply that there are nodes located farther away from itself which can act as the forwarding node. On the other hand, if there are no nodes located in the region between AR and RR, there would be no broadcasts of the same request during the waiting period. In this case, the nodes within AR would broadcast their own copies of RREQ once the wait duration times out. Any subsequent node which rebroadcasts the route request also sends an alert message in the same manner. Thus, for each hop, the forwarding node is likely to be towards the periphery of the RR. Therefore the number of hops is minimized.

D. Optimal path finding

The routing decision is done according to nodes that are located at a distance with two hop sender node. Access to information for node that are located at a distance with two hop to sender node, each node periodically calls from neighbors that their routing table information including their neighbors they are sent to the requesting node. With access to the neighbor`s table sender node in addition to the information nodes that are in one hop themselves, the information will be available to the nodes that are located in hop jumps. To reduce the overhead caused of this information, nodes only request the required information. In our algorithm only will be ask information about the remaining energy of nodes. Also, to reduce the traffic caused by sending information packets, these packets with the piggyback method on the acknowledgement packets will be sent to the applicant node. Efficiency of this method is due to the fact that whatever the value awareness sender node is more extensive than its neighbor nodes, a route that is selected for the forward chosen can be more accurate and more efficient and this causes that prevent of sending to the routes have nodes with lower energy.

4. PERFORMANCE ANALYSIS

In this sub-section, the comparison results of the Hybrid Optimal hop-alert Routing Algorithm (HORA) algorithm are discussed. The results of this technique have been compared with the results of the previous LBORF (Location based optimal route finding), EEAR (Energy efficient ant based routing algorithm). The LBORF and EEAR protocols are selected for the comparison with HORA because these protocols are advanced protocols of providing better quality of service (QOA). Table 1 shows the list of parameters used during simulation by NS-2.

Table-1 Simulation parameters indication

Simulation Parameters	Values
Area	1200*1200
No of Nodes	100
Simulation Time	50ms
Routing algorithm	AODV
Initial Power	150J
Transmit power	0.03J
Receiving power	0.03J

Table-2 Comparison of existing and proposed algorithm

PARAMETERS	LBORF	EEAR	HORA (PROPOSED)
QOS of network	47%	53%	58%
Average delay	0.038ms	0.033ms	0.031ms
Resource sharing	87%	91%	92%
Energy consumption	0.062	0.069	0.074
Network lifetime	0.087	0.091	0.092
Packet loss percentage	38%	33%	31%

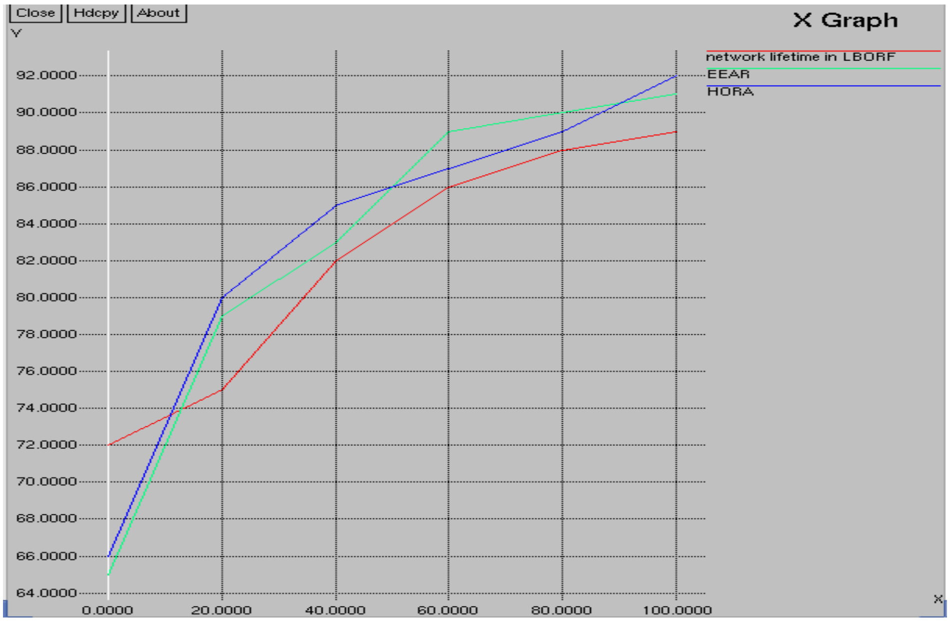

Figure-1 comparison of network lifetime

From figure-1 we found that proposed HORA have more lifetime about 92% comparing with other algorithms

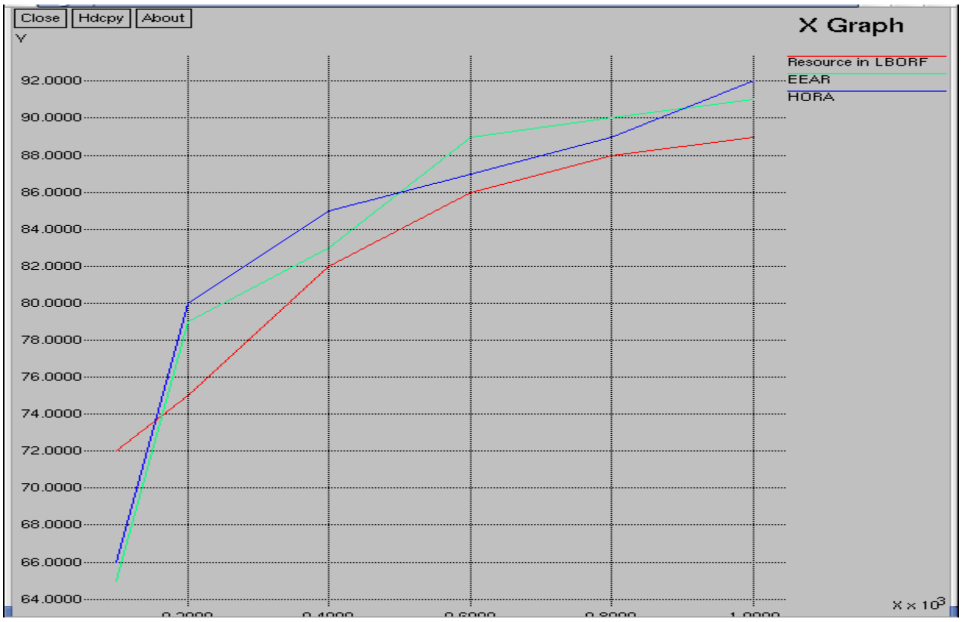

Figure-2 Analysis of resource

This figure 2 shows that more amount of resource is shared by our proposed mechanism.

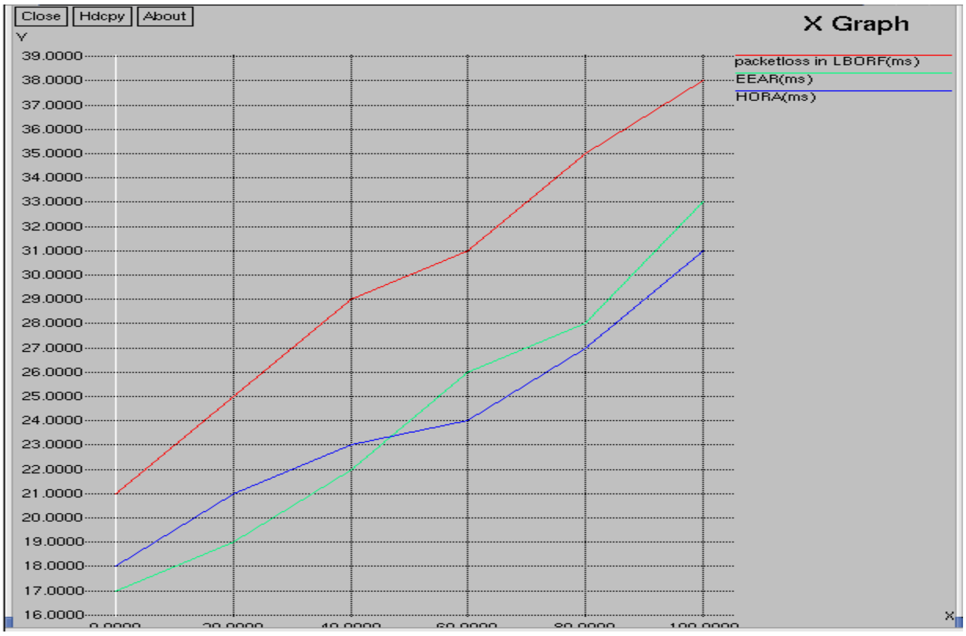

Figure-3 Analysis of packet loss

Figure 3 shows the Packet loss percentage is calculated by subtract to the number of data packets sent to source and number of data packets received destination through the number of packets originated by the application layer of the source.

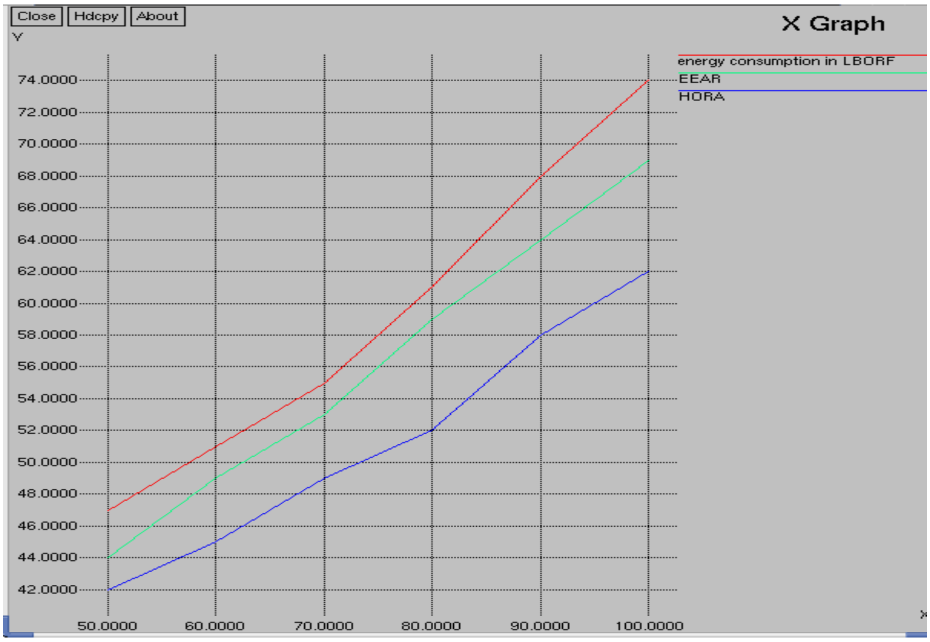

Figure-4 Comparison of energy consumption

Figure 4 show delay was predictable because of packets should take to reach the destination in the shortest way.

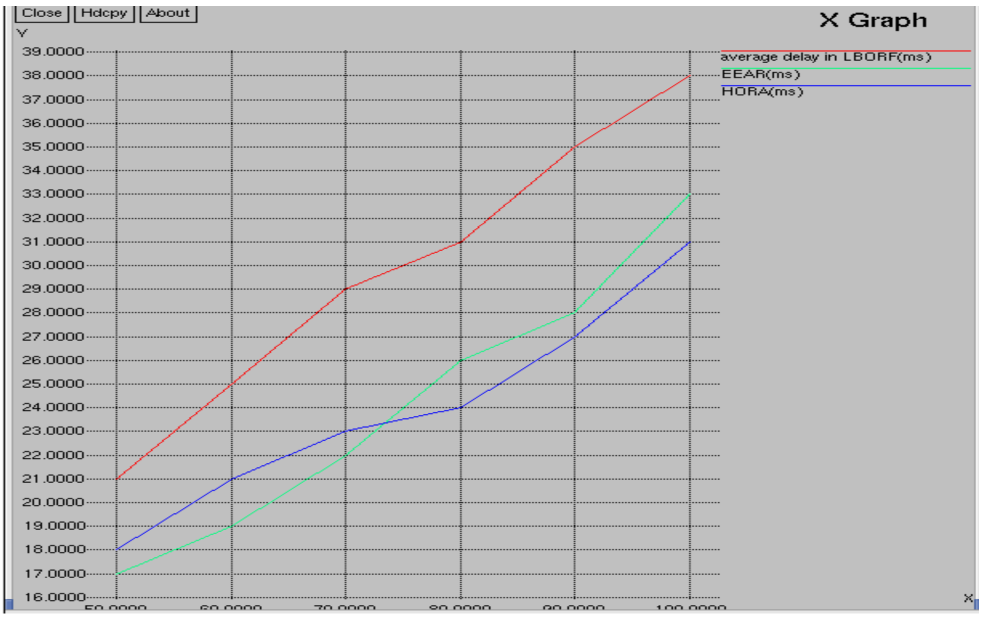

Figure-5 Comparison of average delay

Figure-5 shows that delay is 0.031ms in our proposed algorithm while EEAR is 0.033ms and LBORF is 0.038ms

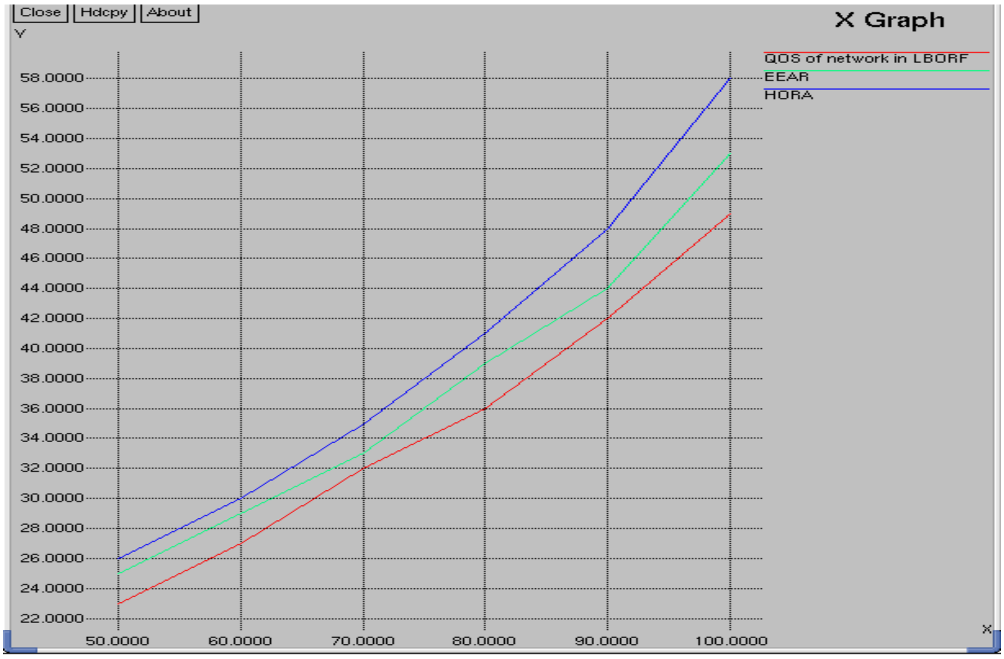

Figure-6 QOS analysis between three algorithms

5. CONCLUSION

We have developed HORA, a new kind of routing algorithm for the WSN network architecture of the current real-time applications. Hop Alert actively tries to reduce the number of nodes taking part in the route discovery phase by making use of an alert message which restricts some nodes from participating in route request forwarding. We show in our simulations that this helps to obtain paths with shorter hop counts while using up fewer transmissions. We compared the performance of EEAR and LBORF in the same typical simulation scenarios. The simulation results for packet delivery ratio and average packet delay show that HORA performed better than EEAR and LBORF. We will investigate the other performance metrics of HORA and design more flexible simulation scenarios.

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