ALBAR-H: Load Balancing Around Holes in Wireless Sensor Networks

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***Abstract*—** In wireless sensor networks the formation of hole is inevitable because of the structure of the sensor networks. When a hole is formed reliability is decreased. With the formation of holes in sensor networks Quality of service decreases eventually. Network Coverage is an important factor to detect a specified area. In order to maintain the coverage quality of the sensor networks, we propose a light weight protocol, ALBAR-H which is a variant of ALBA-R mechanism to detect localization errors in the sensor networks. In this algorithm , healing is performed with the nodes which are located at a right distance from the hole. Performance results through ns2 show that ALBAR-H shows a better performance by finding the localization errors.

Keywords- *WSN, ALBA,ALBA-R, Hole Healing Algorithm*

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I. INTRODUCTION

Wireless Sensor Network consists of a large number of sensor nodes with sensing, processing and transmission capabilities. In recent decades, wireless sensor technology leads several sectors such as military surveillance, building automation etc. Many analyses in WSNs are attracted within the deployment of sensors that make sure both network coverage and connectivity. Random deployment is easy, however it causes many issues. The sensor nodes perform their data collection duties unattended, and the corresponding packets are then transmitted to a data collection point (the sink) via multihop wireless routes .

The majority of the research on protocol design for WSNs has focused on MAC and routing solutions. An important class of protocols is represented by geographic or location based routing schemes.

Greedy Forwarding is prone to the problem of dead ends, i.e., to packet being sent to nodes on the edge of connectivity hole. In this case, there are no relays in the direction of sink, and packets have to be discarded eventually. For this problem many solutions have been proposed. They range from planar graph to flooding based techniques and many face routing techniques.. However, planarization does not work well in the presence of localization errors and realistic radio propagation effects , as it depends on unrealistic representations of the network. In this paper, we propose an approach to the problem of routing around connectivity holes that works in any connected topology without the overhead and inaccuracies incurred by methods based on topology planarization.

In this paper, we propose an approach to the problem of routing around connectivity holes that works in any connected topology without the overhead and inaccuracies incurred by methods based on topology planarization. A cross layer protocol ALBAR-H is defined, where the features of existing protocol ALBAR are combined with a hole healing algorithm in order to yield more efficient protocol to route around connectivity holes.

The paper is organized as follows. We start describing the ALBAR-H framework in section II. The system is composed of several schemes, namely, ALBA(Section II-A), Rainbow (Section II-B), ALBA-R(Section II-C), ALBAR-H(Section II-D). Section III illustrates the performance evaluation of our approach. We draw our conclusions in section IV.

Connectivity Holes give rise to a number of coverage and routing problems. Hole detection guarantees data reliability and efficient routing.

II. SYSTEM MODEL

A. ALBA

ALBA[1] is a greedy forwarding protocol for wireless sensor networks. It is designed to take congestion and traffic load balancing into consideration. Nodes alternate between awake/asleep modes according to independent wake-up schedules with fixed duty cycle d. Packet forwarding is implemented by having the sender polling for availability its awake neighbors by broadcasting RTS packet. Available neighbor nodes respond with CTS packet carrying information through which the sender can choose the best relay. Every prospective relay is characterized by two parameters: queue priority index (QPI) and the geographic priority index (GPI).

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B. RAINBOW MECHANISM

Rainbow [1] selects a node for packet forwarding. Rainbow Mechanism is used to avoid local minima in routing through a coloring scheme. Based on its previous success in finding relays the nodes assign themselves different color which is again used in communication The basic idea for avoiding connectivity holes is that of allowing the nodes to forward packets away from the sink when a relay offering advancement towards the sink cannot be found. To remember whether to seek for relays in the direction of the sink or in the opposite direction, each node is labeled by a color chosen among an ordered list of colors and searches for relays among nodes with its own color or the color immediately before in the list. Rainbow determines the color of each node so that a viable route to the sink is always found.

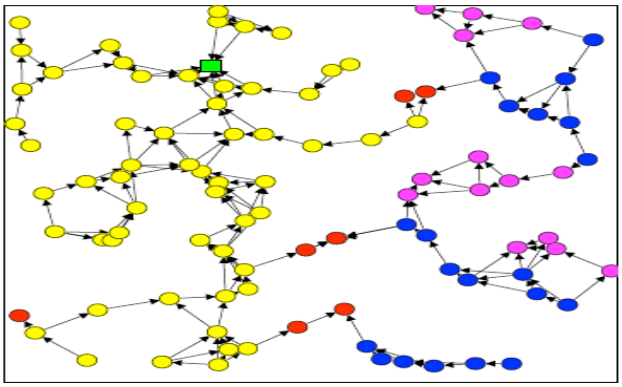

Figure 1: Rainbow Mechanism

C. ALBA-R

Load balancing is needed to effectively use available resources and keep the sources and keep the nodes energy consumption balanced by equally distributing the load. A detailed description of the working of ALBA-R protocol is shown in the below flowchart.

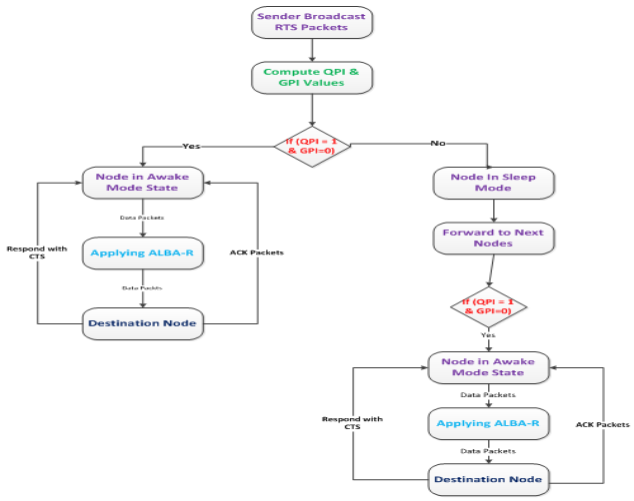

Figure 2: ALBA-R Flowchart

D. ALBAR-H

In this paper we propose an approach ALBAR-H, where the features of ALBA-R are used as existing system. ALBAR and Hole Healing Algorithm are combined in order to detect and heal the connectivity holes so that localization errors are reduced to great extent. In this approach first a hole is detected by QUADRANT rule. In this rule, each node is capable of discovering itself whether it is a stuck node or not, irrespective of the existence of sink node.

In Quadrant rule, the communication range of every node is partitioned into 4 quadrants of 90^{o}. Each quadrant verifies for the incidence of atleast one hop neighbor.

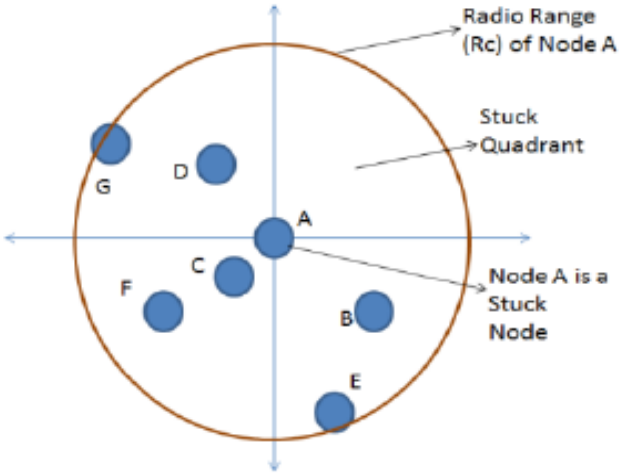

Figure 3: Quadrant rule

After stuck nodes are discovered by QUADRANT rule, they will verify its location information next to the existing boundary range of specified region. In hole healing process virtual forces such as attractive and repulsive forces are involved. The attractive force attracts the nodes from hole. centre towards it. The repulsive force exists between the nodes which overlap

In ALBAR-H healing process takes place between the nodes which are at a proper distance from the hole. In this process, the Hole Manager(HM) node will be responsible for the broadcasting of hole healing message. The HM node informs regarding the healing process to the nodes involved in it.

III. SIMULATION ANALYSIS

For verification, we have implemented ALBAR-H in NS2. The simulation scenario of ALBAR-H is as given below

Table 1: Simulation Parameters

Parameter	Value
Channel Type	Wireless channel
Radio propagation model	Two way Ground
Network Interface Type	Wireless phy
MAC type	IEEE 802.11
Interface queue type	PriQueue

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Link layer type	**LL**
Antenna Model	**Omni Antenna**
Simulation Time	**100ms**
Number of nodes	**35**
Topology Area	**1000×1000**
Routing Protocol	**DSDV**

Network simulator is an event driven discrete simulator. It is an extensively used event simulator for various test scenarios. To test our proposed work, the parameters tabulated in above table were used.

A. Metrics

The following metrics have been investigated: *throughput, packet delivery ratio* and *energy consumption*

Throughput

Throughput is the amount of data sent to the destination.

Energy consumption

It is defined as the average amount of energy spent by all nodes to successfully deliver a packet to sink

Packet Delivery Ratio

It is defined as the ratio between the number of packets transmitted by a traffic source and the number of packets received by a traffic sink.

B. Results

We compare ALBAR-H with ALBA-R in the same simulation scenario

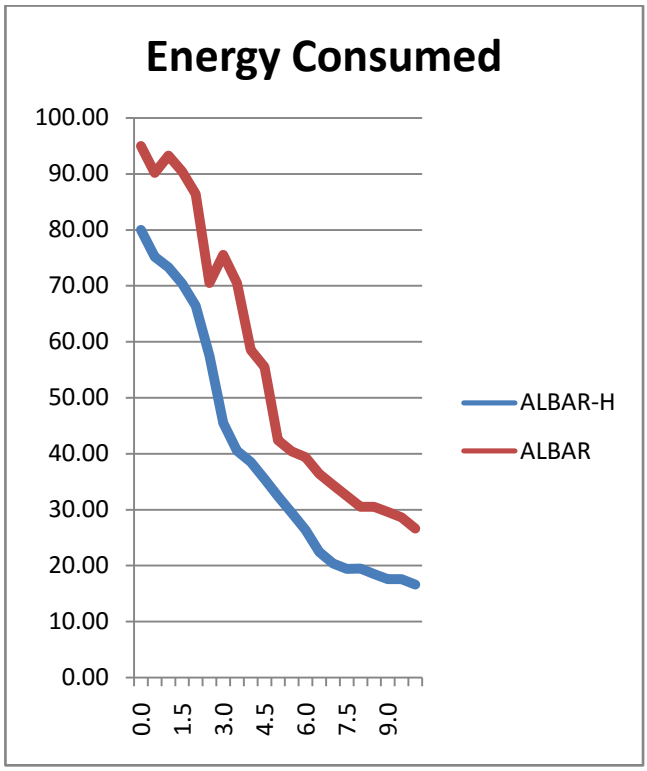

Figure 4: Energy Consumed

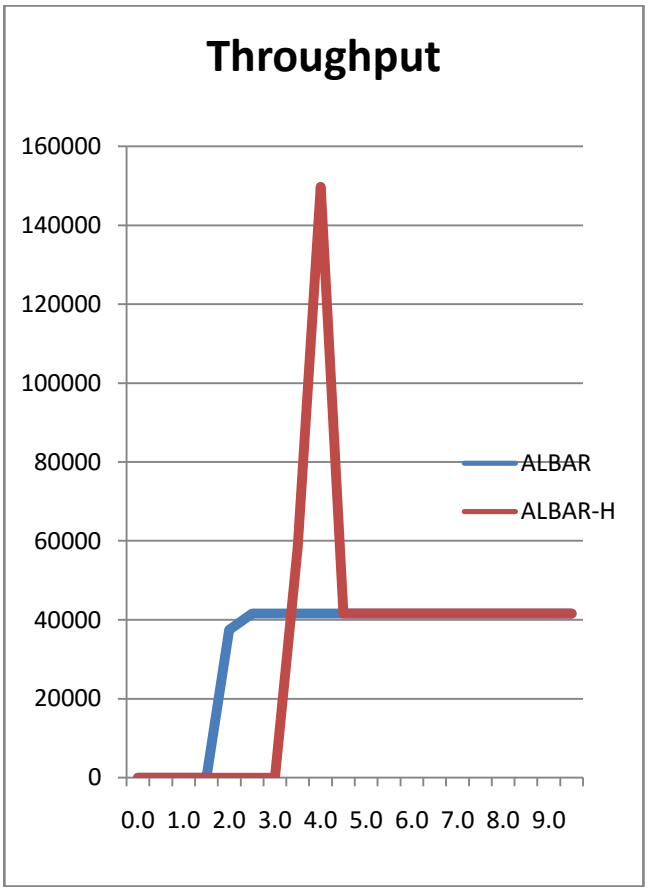

Figure 5: Throughput

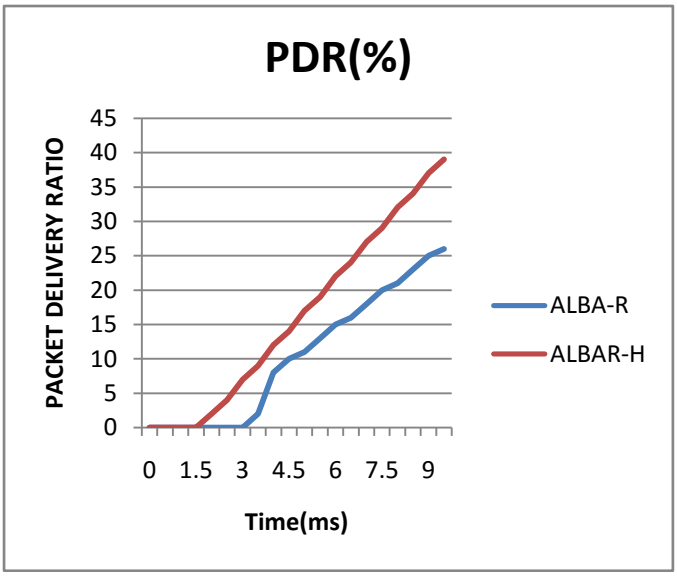

Figure 6: Packet delivery Ratio

C. RESULT ANALYSIS AND DISCUSSIONS

From figures 4 ,5 and 6 we can conclude that the ALBAR-H protocol achieves better performance in terms of energy consumption , throughput and packet delivery ratio than existing ALBAR protocol.

IV. CONCLUSION

The proposed variant of ALBAR i.e ALBAR-H detects and reduces the localization errors and improves the network coverage. ALBAR-H consumes less energy when compared to that of existing ALBAR. The proposed work even reduces the localization errors and hence proves to be efficient than that of the existing protocols.

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