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The Secure ALBA-R Scheme For Wireless Sensor Networks

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***Abstract*— This paper aims to information about remote and hostile locations are gathered through the deployed wireless sensor nodes connected to form a Wireless Sensor Network (WSNs). The sensor nodes perform their data collection tasks unattended, and the corresponding packets are then transmitted to a data collection point (the sink) via multi-hop wireless routes (WSN routing or convergecasting). ALBA-R is a protocol for convergecasting in wireless sensor networks. ALBA-R features the cross-layer integration of geographic routing with contention-based MAC for relay selection and load balancing (ALBA) as well as a mechanism to detect and route around connectivity holes (Rainbow). ALBA and Rainbow (ALBA-R) together solve the problem of routing around a dead end without overhead-intensive techniques such as graph planarization and face routing. The protocol is localized and distributed, and adapts efficiently to varying traffic and node deployments. Through extensive ns2-based simulations we show that ALBA-R significantly outperforms other convergecasting protocols and solutions for dealing with connectivity holes, especially in critical traffic conditions and low density networks. Our results show that ALBA-R is an energy-efficient protocol that achieves remarkable performance in terms of packet delivery ratio and end-to-end latency in different scenarios in network.**

***Keywords*—ALBA-R, Convergecasting, MAC, Relay selection, Geographic routing, Rainbow mechanism, Energy efficient, PDR**

I. INTRODUCTION

In this paper, 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. Specifically, we define a cross-layer protocol, named ALBA for Adaptive Load Balancing Algorithm, whose main ingredients (geographic routing, load balancing, contention based relay selection) are blended with a mechanism to route packets out and around dead ends, the Rainbow protocol. The combination of the two protocols, called ALBA-R, results in an integrated solution for convergecasting in WSNs that, although connected, can be sparse and with connectivity holes.

According to its first and simplest formulation, geographic routing concerns forwarding a packet in the direction of its intended destination by providing maximum per-hop advancement. In dense networks, this greedy approach is quite successful, since nodes are likely to find a path toward the sink traversing a limited number of intermediate relays. Conversely, in sparse networks, packets may get stuck at dead ends, which are located along the edge of a connectivity hole, resulting in poor performance.

A number of ideas have, therefore, been proposed to address the problem of routing around dead ends. A first set of approaches stems from the work of Kranakisetal. WSN topologies are first “planarized”. Geographic routing over planarized WSNs is then obtained by employing greedy routing as long as possible, resorting to planar routing only when required, for example, to get around connectivity holes. Heuristic rules are then defined for returning to greedy forwarding as soon as next-hop relay scan be found greedily.

This is because spanner formation protocols assume that the network topology is modeled by a UDG, and the correctness of the approach cannot be guaranteed when this is not the case, as in most realistic situations. To make planarization work on real networks, a form of periodic signaling must be implemented to check that no links cross, as performed by the Cross-Link Detection Protocol (CLDP). However, this is a transmission intense solution for WSNs, which eventually affects the network performance.

For a comprehensive overview of planar graph routing, the reader is referred to the survey by Frey. A different class of solutions for handling dead ends is based on embedding the network topology into coordinate spaces that decrease the probability of connectivity holes. In the former case, the coordinates of each node are the vector of the hop distance between the node and each of a set of beacons. Greedy forwarding is typically performed over the virtual coordinate's space.

This decreases the occurrence of dead ends, but does not eliminate them. Topology warping schemes are based on iteratively updating the coordinates of each node based on the coordinates of its neighbors, so that greedy paths are more likely to exist. These approaches are referred to as "geographic routing without location information," as they do not require accurate initial position estimates. Both methods, however, present a non-negligible probability that packets get stuck in dead ends.

II. LITERATURE SURVEY

Stojmenovicproduceda recent availability of small, inexpensive low-power GPS receivers and techniques for finding relative coordinates based on signal strengths, and the need for the design of power efficient and scalable networks provided justification for applying position-based routing methods in ad hoc networks. A number of such algorithms were developed recently. This tutorial will concentrate on schemes that are loop-free, localized, and follow a single-path strategy, which are desirable characteristics for scalable routing protocols.

In existing system use routing protocols have two modes: greedy mode (when the forwarding node is able to advance the message toward the destination) and recovery mode (applied until return to greedy mode is possible). Methods also differ in metrics used (hop count, power, cost, congestion, etc.), and in past traffic memorization at nodes (memory-less for memorizing past traffic).

K. Seada, aims the absence of location errors, geographic routing - using a combination of greedy forwarding and face routing - has been shown to work correctly and efficiently. The effects of location errors on geographic routing have not been studied before. In this work we provide a detailed analysis of the effects of location errors on the correctness and performance of geographic routing in static sensor networks. First, we perform a micro-level behavioral analysis to identify the possible protocol error scenarios and their conditions and bounds.

Then, we present results from an extensive simulation study of GPSR and GHT to quantify the performance degradation due to location errors. Our results show that even small location errors (of 10% of the radio range or less) can in fact lead to incorrect (non-recoverable) geographic routing with noticeable performance degradation. We then introduce a simple modification for face routing that eliminates probable errors and leads to near perfect performance. In this project have some drawbacks.

III. PROPOSED SYSTEM

In proposed system an approach to the problem of routing around connectivity holes that works in any connected topology without the overhead and inaccuracies increased by methods based on the topology planarization. The combination of the protocol called alba-r routes in an integrated solution for convergecasting in WSNs that although connected can be specific and with connectivity holes. WSNs that integrate awake/sleep schedules, MAC, routing, traffic load balancing, and back-to-back packet transmissions.

Nodes alternate between awake/sleep 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 a Request-to-Send (RTS) packet for jointly performing channel access and communicating relevant routing information (cross layer approach). Available neighboring nodes respond with Clear-to-Send (CTS) packet carrying information through which the sender can choose the best relay.

Relay selection is performed by neighbors offering "good performance" ,node of neighbor only awake that time, so it increase a network lifetime. Then it achieves performance superior to existing protocols in terms of energy efficiency, packet delivery ratio (PDR) and End-to-end latency.

Rainbow mechanism allows guarantee packet delivery in realistic deployment. Simulation results also show better performance than that of two recent proposals for routing around dead ends.

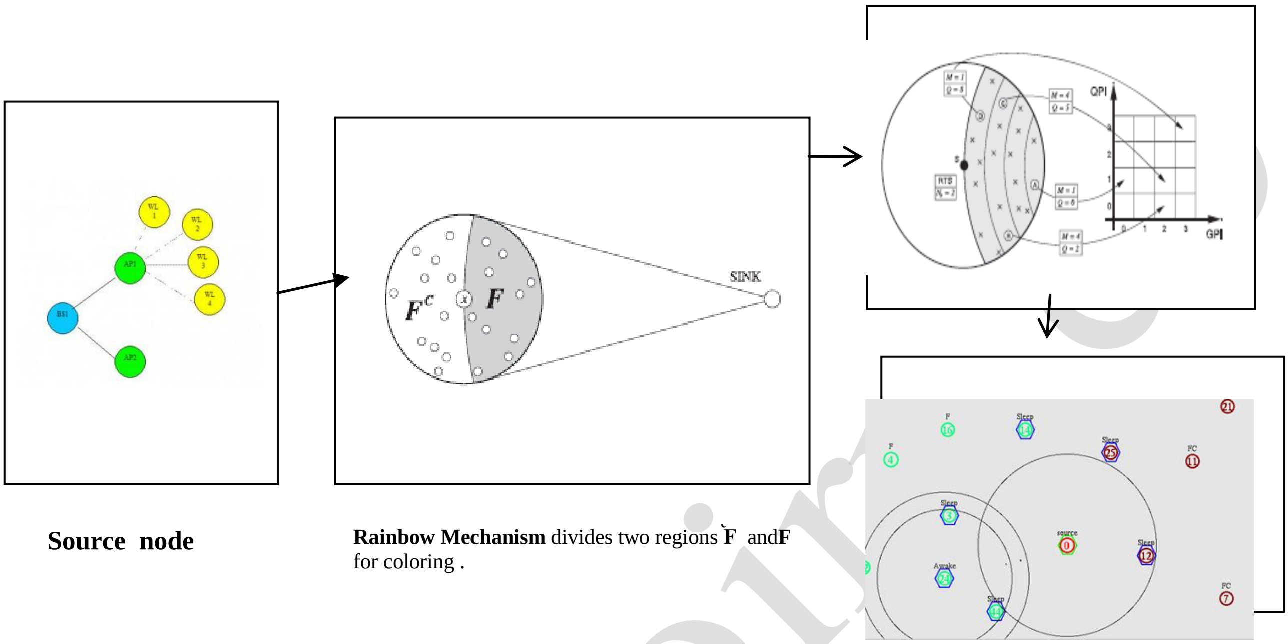

Fig.1. Block Diagram for ALBA-R Mechanism

A. THE ADAPTIVE LOAD-BALANCING ALGORITHM- RAINBOW (ALBA-R)

The protocol proposed in this ALBA: Adaptive Load Balancing Algorithm. Convergercasting is used for here to provide a cross-layer solution in WSNs that integrates awake/asleep schedules, MAC, routing, traffic load balancing, and back-to-back packet transmissions. 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 a Request-to-Send (RTS) packet for jointly performing channel access and communicating relevant routing information (cross layer approach). Available neighboring nodes respond with Clear-to-Send (CTS) packet carrying information through which the sender can choose the best relay. Relay selection is performed by preferring neighbors offering “good performance” in forwarding packets. Positive geographic advancement toward the sink (the main relay selection criterion in many previous solutions) is used to discriminate among relays that have the same forwarding performance.

Positive geographic advancement toward the sink (the main relay selection criterion in many previous solutions) is used to discriminate among relays that have the same forwarding performance. The potential relay keeps a moving average M of the number of packets it was able to transmit back-to-back, without errors, in the last _ forwarding attempts.Every prospective relay is characterized by two parameters:

- *Queue priority index* (QPI),
- G*eographic priority index* (GPI).

The sender S is represented by a black circle, while crosses and white circles denote asleep and awake neighbors, respectively. Awake nodes are the only ones available at the time the RTS is broadcast. The forwarding area is colored light gray, and the GPI regions are delimited by arcs centered at the sink.

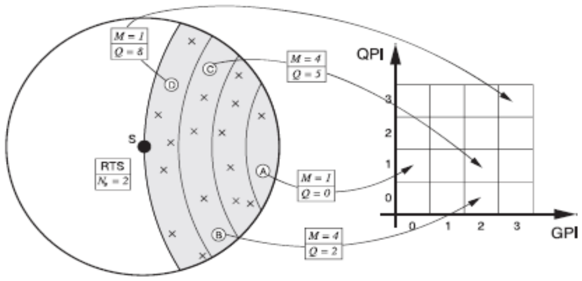

Fig.2. Computing the QPI and GPI values.

B. QUEUE PRIORITY INDEX (QPI)

The queue priority index is calculated based on the burst size of the packet transmission and their moving average and the number of packets in an eligible relay queue.

In this example, the source S wants to send a burst of NB ¼ 2 packets. Among the awake nodes, A has an empty queue, but also a bad forwarding record (M ¼ 1); hence, its QPI is 2. Nodes B and C have both M ¼ 4.

However, B has a smaller queue and therefore its QPI is 1, whereas that of C is 2. A sender node queries neighbors in increasing order of QPI. The sender performs channel sensing prior to packet transmission, to make collisions with ongoing handshakes unlikely.

$$\text{QPI} = \min\left\{\lceil (Q + N_B)/M \rceil, N_q\right\}$$

Where,

Nq - maximum allowed QPI

Q - The number of packets, queue of the nodes eligible for relaying

M - Moving average of the packets

NB - Burst (packet transmission)

C. GEOGRAPHIC PRIORITY INDEX (GPI)

The geographic priority index is assigned by the range of the distance of each node from the sink. Based on the positioning information (as provided to a node by GPS, or computed through some localization protocol), and on the knowledge of the location of the sink, each node also computes its GPI, which is the number of the geographic region of the forwarding area of the sender where a potential relay is located. The numbering of GPI regions ranges from 0 to Nr − 1.

D. THE RAINBOW MECHANISM USING ALBA-R

In this section, describe Rainbow, the mechanism used by ALBA to deal with dead ends. 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 toward 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. Hop-by-hop forwarding then follows the rules established by ALBA. More formally, let x be a node engaged in packet forwarding. We partition the transmission area of x into two regions, called F and FC that include all neighbors of x offering a positive or a negative advancement toward the sink, respectively.

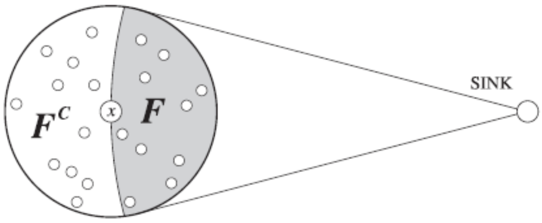

Fig.3. The F and F' regions

When x has a packet to transmit it seeks a relay either in F or FC according to its color Ck, selected from the set of colors fC0; C1; C2; C3; . . .g. Nodes with even colors C0; C2; . . . search for neighbors in F (positive advancement). Nodes with odd color C1; C3; . . . search for neighbors in FC (negative advancement). Nodes with color Ck, k _ 0, can volunteer as relays only for nodes with color Ck or Ckþ1. Nodes with color Ck,k> 0, can only look for relays with color Ck_1 or Ck. Finally, nodes with color C0 can only look for relays with color C0.3 the nodes assume their color as follows: Initially, all nodes are colored C0 and function according to the standard ALBA rules. If no connectivity holes are encountered, all nodes remain colored C0 and always perform greedy forwarding. Since the nodes on the boundary of a hole cannot find relays offering positive advancement, after a fixed number failed attempts, they infer that they may actually be dead ends and correspondingly increase their color to C1.

According to Rainbow, C1 nodes will send the packet away from the sink by searching for C0 or C1 nodes in region FC. If a C1 node cannot find C1 or C0 nodes in FC, it changes its color again becoming a C2 node. Therefore, it will now look for C2 or C1 relays in F. Similarly, a C2 node that cannot find C2 or C1 relays in F turns C3 and starts searching for C3 or C2 nodes in FC.

This process continues until all nodes have converged to their final color. Note that, at this point, any node that still has color C0 can find a greedy route to the sink, i.e., a route in which all nodes offer a positive advancement toward the sink. In other words, once a packet reaches a C0 node, its path to the sink is made up only of C0 nodes.

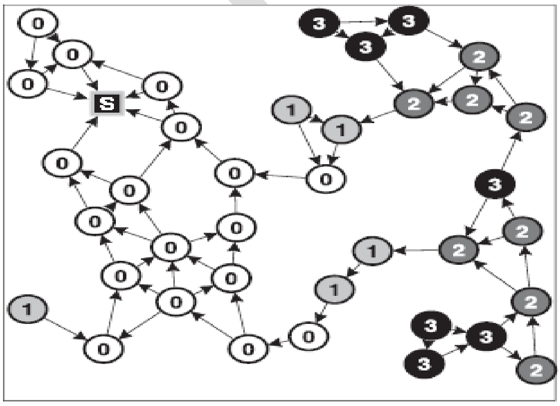

Fig.4.Rainbow coloring

Similarly, packets generated or relayed by Ck nodes follow routes that first traverse Ck nodes, then go through Ck_1 nodes, then Ck_2 nodes, and so on, finally reaching a C0 node. As soon as a C0 node is reached, routing is performed according to ALBA greedy forwarding. Sample topology where four colors which is sufficient to label all nodes.

In the above figure, the numbers in the nodes indicate the color they assume. Higher colors are rendered with darker shades of gray. A proof of the correctness of the Rainbow mechanism is given in the supplemental material document, available online. That proof, including convergence of the coloring mechanism in finite time and the loop-freedom of the determined routes, is performed through mathematical induction on the number h of changes of color in the route from a node to the sink. ALBA-R correctness is not affected by the presence of localization errors or by the fact that the topology graph is not a UDG, showing that our protocol is robust to localization errors and realistic propagation behaviors.

IV. RESULT ANALYSIS

A. CREATING THE NETWORK SCENARIO AND NODE

In communication networks, a topology is a usually schematic description of the arrangement of a network, including its nodes and connecting lines. There are two ways of defining network geometry: the physical topology and the logical (or signal) topology. The physical topology of a network is the actual geometric layout of workstations. Logical (or signal) topology refers to the nature of the paths the signals follow from node to node. The number nodes is going to participate in the simulation is decided. We hence use only a logical topology as it is wireless environment.

Node creation is nothing but the creation of the wireless nodes in the network scenario that is decided. Node configuration essentially consists of defining the different node characteristics before creating them. They may consist of the type of addressing structure used in the simulation, defining the network components for mobile nodes, turning on or off the trace options at Agent/Router/MAC levels, selecting the type of adhoc routing protocol for wireless nodes or defining their energy model. For instance, to create a mobile node capable of wireless communication, one no longer needs a specialized node creation command.

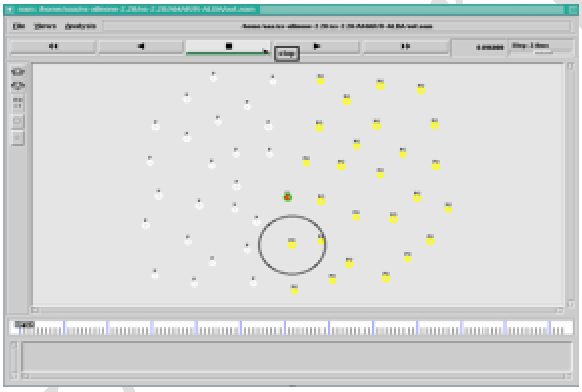

Fig.5.1. Creating the network scenario and node

B. RAINBOW MECHANISM

In the mechanism used to avoid the dead end problem and connecting hole. Here labeling color to the nodes. 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 toward the sink cannot be found.

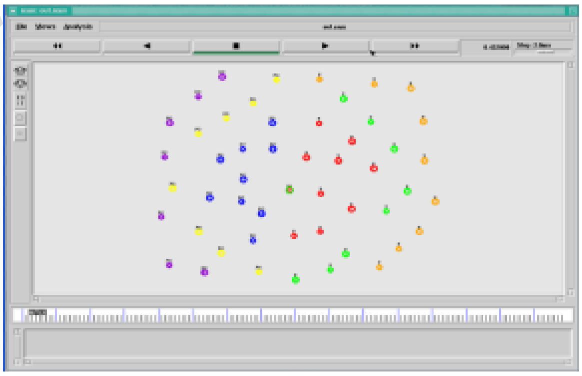

Fig.5.2. Coloring the nodes by Rainbow mechanism of regions.

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. We partition the transmission area of x into two regions, called F and FC that include all neighbors of source offering a positive or a negative advancement toward the sink. Based on the reply from the region the source finds the path to forwarding the data.

C. SLEEP & AWAKE SCHEDULE

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 broad- casting an RTS packet for jointly performing channel access and communicating relevant routing information (cross-layer approach) by using a QPI and GPI values. Available neighboring nodes respond with clear-to-send (CTS) packet carrying information through which the sender can choose the best relay.

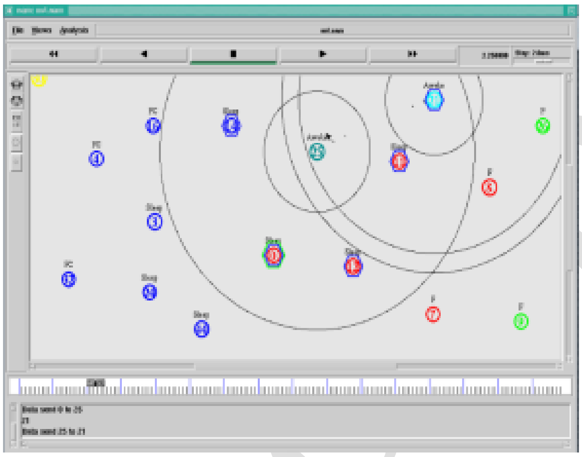

Fig.5.3. Packets forwarding by sleep & awake schedule.

D. PERFORMANCE EVALUATION

During simulation time the events are traced by using the trace files. The performance of the network is evaluated by executing the trace files. The events are recorded into trace files while executing record procedure. In this procedure, we trace the events like packet received, Packets lost, Last packet received time etc. These trace values are write into the trace files. This procedure is recursively called for every 0.05 ms. so, trace values recorded for every 0.05 ms.

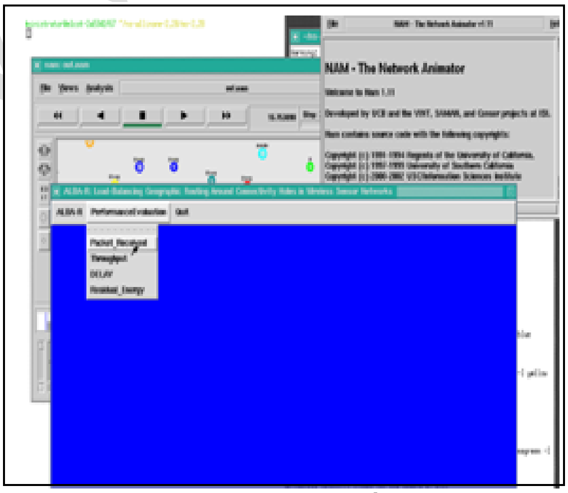

Fig.5.4. NAM simulator

E. PACKET RECEIVED

Send packets from one node to another, how many packets are received for a node. In ns2, no packets are actually sent and tell next node that a packet arrives.

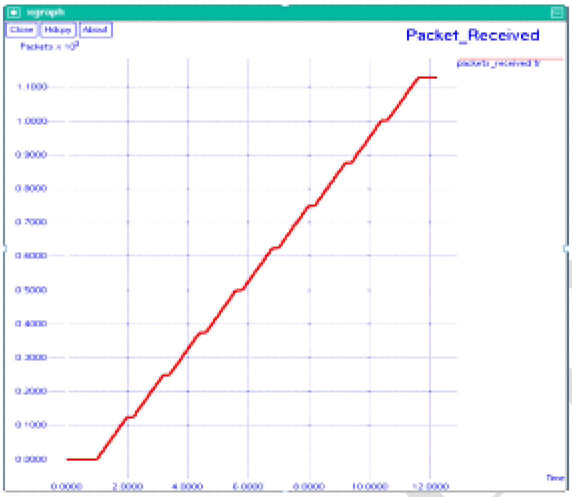

Fig.5.5. Packet Received

F. THROUGHPUT

The amount of data transferred from one place to another or processed in a specified amount of time. Data transfers rates for disk drives and network are measured in terms of throughput. The average throughput is the throughput per unit of time. Throughput are measured by Kpbs, Mpbs, Gpbs

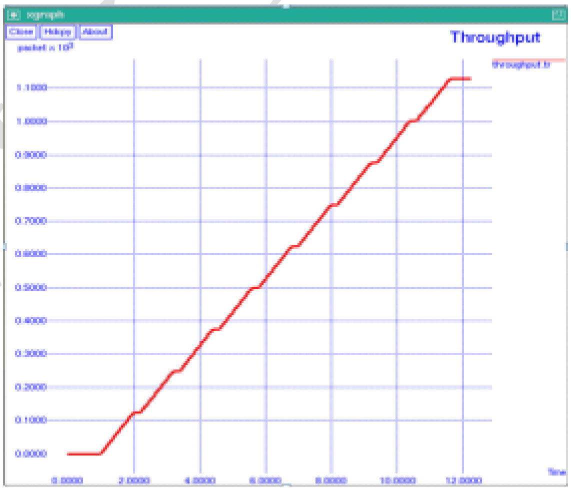

Fig.6.Throughput

G. DELAY

Average of time taken by a packet of data is to arrive in the destination. It also includes the delay caused by route discovery process and the queue in data packet transmission. Only the packet that successfully delivered to destinations that counted. The delay is specified in the duplex-link method is actually the delay on that link.

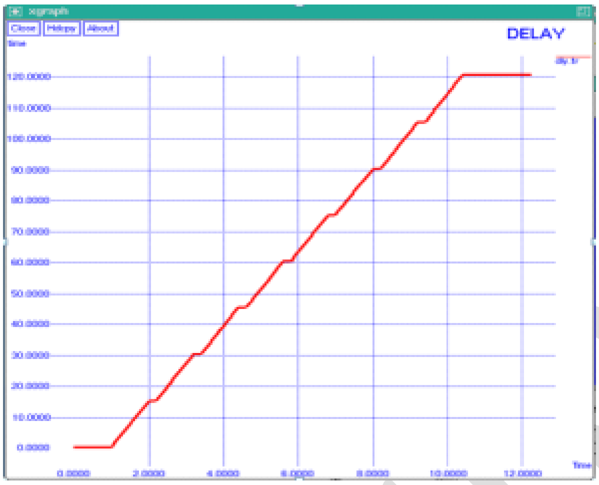

Fig.5.6. Delay

H. ENERGY

The energy represents the energy level of nodes in the network. The energy defined in a node has an initial value that is the level of energy the node has at the beginning of the simulation. This energy is termed as initial energy. The strength of node and vitality required for sustained physical activity. In simulation, the variable “energy” represents the energy level in a node at any specified time.

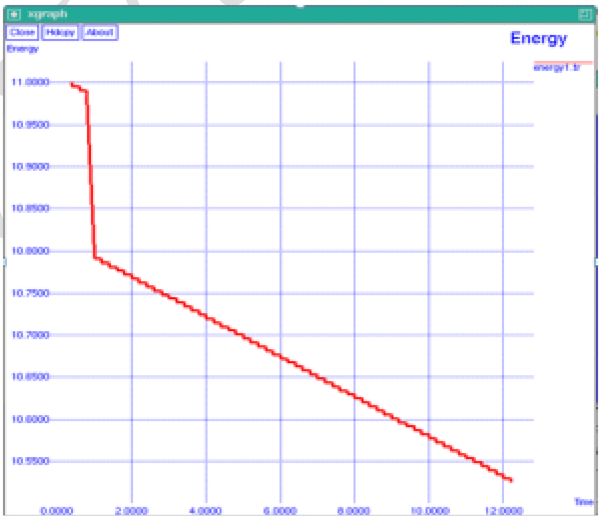

Fig.5.7.Energy

V. CONCLUSION AND FUTURE WORK

ALBA-R combines geographic routing, handling of dead ends, MAC, awake-asleep scheduling, and back-to-back data packet transmission for achieving an energy-efficient data gathering mechanism. To reduce end-to-end latency and scale up to high traffic, ALBA-R relies on a cross layer relay selection mechanism favoring nodes that can forward traffic more effectively and reliably, depending on traffic and link quality. The scheme designed to handle dead ends, Rainbow is fully distributed, has low overhead, and makes it possible to route packets around connectivity holes without resorting to the creation and maintenance of planar topology graphs.

Even though the load balancing and quality of service is assured, it does not mention the need for data security during the routing operations. In future work, a simple key exchange mechanism or a cryptographic technique incorporated with the existing ALBA-R mechanism can make it good enough to consider the protocol it for experimental and real time implementations. Use polynomial bivariate key generation as a key exchange mechanism and one way hash chain algorithm for data security. Consider the remaining energy of node when finding the path. Remaining energy = Initial energy - loss of energy.

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