An Unwavering Routing Protocol for Energy Efficiency in Wireless Sensor Networks

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Abstract- *: The efficient sensor node energy utilization in wireless network is important because the node work with limited battery power. To improve the life time of the sensor network, we must reduce the node energy level consumption for the entire network and also balance the node battery power. The energy constraint sensor nodes in sensors networks operate on limited batteries, so it is a main issue to use energy efficiently and reduce power consumption. In ad hoc networks the communication is based on the signals. Due to the mobility of the nodes the link gets break and the transmission is unreliable. However the routing protocols using encryption schemes require large memory for storing the keys. In further these protocols have been developed without the consideration of energy aware algorithm. In this paper Unwavering routing protocol for wireless sensor networks is developed to identify the shortest path with the energy consideration in each path to make the node power consumption widely distributed to increase the network lifetime. The proposed protocol performance has been examined and evaluated with the NS-2 simulator in terms of network lifetime and end-to-end delay.*

Key words: Wireless Sensor Networks (WSN), Power Aware Routing Protocol (PARP), Unwavering Routing Protocol (URP), Route Request (RREQ), Route Reply (RREP), Residual Energy (RE), Ad-hoc on Demand Distance Vector Routing protocol (AODV).

I. INTRODUCTION

New advances in wireless and ubiquitous computing have prompted much research attention in the area of WSN. A WSN can thus be viewed as an intelligent distributed measurement technology adequate for many different monitoring and controls. In contemporary years, the number of WSN deployments for real-life applications e.g., environmental change, agriculture monitoring, export and import, defense and medical application has rapidly grown with a trend expected to further increase in the incoming years[1]. However, energy consumption still remains one of the main obstacles to the diffusion of developing technology, especially in a long network lifetime and a high quality of service are required. Actually nodes are powered by batteries which have limited capacity and, they cannot be replaced or recharged due to environmental constraints. In fact that energy scavenging mechanisms can be adopted to recharge batteries, e.g., through solar panels, piezoelectric, energy is a bounded resource and should be used judiciously. Hence, efficient energy management strategies must be devised at sensor nodes (and then at cluster and network level) to prolong the network duration as much as possible.

In general, data transmission in wireless communication takes more power than data process. However the nodes are transmitting more number of data proportionately their battery powers also get reduced. To reduce the data size we can go for data fusion or aggregation techniques. In integration of multiple data and knowledge is that in which the sensed data from different nodes are fused at certain point suitable for the transmission in its reduced size. Even in the data aggregation there are two types of aggregation. The first type of data aggregation fuses the data gathered from different sources and sends the final fused data in compact size. But the disadvantage behind this approach is it lacks in accuracy and precision of data from various sensor nodes. The second approach combines the data from different sources under the single header and forwards it to the base station. There header packets consolidates and pass it to the base station without any modification to the original data from the sensors. Hence accuracy is improved. Study on energy efficient routing in WSN brings two different broad classifications. They are,

- Clustering approach
- Tree based approach

In this paper, we proposed an unwavering routing protocol for wireless sensor networks which determine a proper path with consideration of node residual battery powers. The proposed protocol aims to increase a lifetime of the overall sensor network by avoiding the unbalanced exhaustion of node battery powers.

II. RELATED WORKS

i. Minimum energy mobile wireless networks

In wireless communication systems, the need for low power becomes even more pronounced when designing Radio

Frequency transceivers for small-sized portable user sets. For wireless network designers, on the other hand, the emphasis has traditionally been on increasing system capacity (e.g., the number of users a base station can support), maximize point-to-point throughput in packet-switching networks, and minimizing network delay.

A distributed network protocol optimized for achieving the minimum energy for randomly deployed ad hoc networks is described [4]. Because the topology is found via a local search in each node's surrounding, this can be applicable to a mobile ad hoc network. The performance of the protocol for a mobile network is simulated and found that the average power consumption per node is significantly low.

ii. A cone-based distributed topology-control algorithm for wireless multi-hop network

Multi-hop wireless networks, such as radio networks, ad-hoc networks and sensor networks are networks where communication between two nodes may go through multiple consecutive wireless links. Dissimilar to wired networks, which typically have a fixed network topology, each node in a WSN can potentially change the network topology by adjusting its transmission power to control its set of neighbors.

Reducing energy consumption has been viewed as perhaps the most important design metric for topology control [5]. There are two standard approaches: (i) reducing the transmission power of each node as much as possible (ii) reducing the total energy consumption through the preservation of minimum-energy paths in the underlying network. These two approaches may simultaneous; reducing the transmission power required by each node may not result in minimum-energy paths or vice versa. There are other metrics to consider, such as network throughput and lifetime. Reducing energy consumption tends to increase network lifetime.

iii. Topology management for sensor networks: exploiting latency and density

For routing in WSN, alternative approaches have been considered [6]: flat multi-hop and clustering. Though Sparse Topology and Energy Management is appliance to both of them, so flat multi-hop routing is used. For clustered approaches which are possibly hierarchical, the scheme can be used to reduce the energy of the cluster heads, although the gains are expected to be less dramatic. Topology management techniques, called span have been proposed for flat multi-hop routing. They operate on the assumption that the network capacity needs to be preserved. As a result, the energy reduction is approximately the same whether the network is in the transfer or monitoring state, as no distinction is made between them. Both techniques trade off network density for energy savings.

iv.Energy-efficient Communication protocol for wireless micro sensor networks

Micro sensor networks can contain hundreds or thousands of sensor nodes. It is adorable to make these nodes as low cost and energy-efficient as possible and rely on their large numbers to obtain high quality results [7].

Low Energy Adaptive Clustering Hierarchy, a clustering routing protocol that minimizes global energy usage by distributing the load to all the nodes at different points in time. Low Energy Adaptive Clustering Hierarchy perform static cluster algorithm by requiring nodes to volunteer to be high-energy cluster-heads (CH) and adapting the corresponding clusters based on the nodes that choose to be cluster-heads at a particular time. In different time, every node have the burden of acquiring data from the nodes in the cluster, data fusing to obtain an aggregate signal, and transmitting this aggregate signal to the base station. Low energy adaptive clustering hierarchy is completely distributed, and does not require information from the base station, and also a nodes does not require knowledge of the global network in order for low energy adaptive clustering hierarchy to operate.

v. Next century challenges: scalable Coordination in sensor networks

Different context have been considered for the application of small-scale networks of devices for sensing and actuation tasks. Difference process control and automation tasks in factories have traditionally used networks of embedded systems known as control network to efficiently perform their monitoring tasks. These control networks today consist of a centralized processor with the communication between many tens of sensors and actuators. Simple networks of integrated sensors have been proposed for military awareness situations [8]. These networks schedule sensor transmission using TDMA methods, and provide for automatic discovery of neighbors and cooperative detection by sensors.

vi. Topology control for wireless sensor Networks

Mobile ad hoc networks (MANETs) and WSN have attracted extensive research interests in recent years. A comprehensive survey on WSNs can be found and the references therein. The research challenges and directions for

MANETs can be found [9]. Although sharing many similarities with MANET/WSNs, a two-tiered WSN has its unique underlying structure and application scenarios such as mission-driven BS placement. Compared to MANET/WSNs, and despite their potentially wide applications, two-tiered WSNs have not yet been heavily explored.

III. EXISTING PROTOCOL

The PARP (Power Aware Routing Protocol) protocol has robust nodes. These robust nodes serve as the backbone for the routing in wireless sensor networks. The remaining sensor nodes are public sensor nodes. Each robust node maintains a table about power of other sensor nodes. So in the route, each robust node will compute the end-to-end power is estimated and updated periodically by each robust node. Therefore packets are forwarded through robust nodes to the destination sensor nodes. If source node S need to send data to node destination D, it want to consider the case robust node location or whether source node itself a robust node [2] or not. Robust node will construct the path from source to destination by the PAPR algorithm. Many paths will valid for the min-max conditions in PAPR algorithm but best path in those paths are not consider in this algorithm.

IV. PROPOSED PROTOCOL

The communication in mobile ad hoc network is based on electronic signals, so there is chance to communication link will get break. This will happen commonly because of the nodes present in the network are moving around the region. For example consider the figure 1, three nodes are named a, b and c.

The node b within the range node a and node c, but node a is not within the range of node c also node c is not within the range of node a, Therefore transmissions between the node a and node c by the node b it act as intermediate between node a and node c.

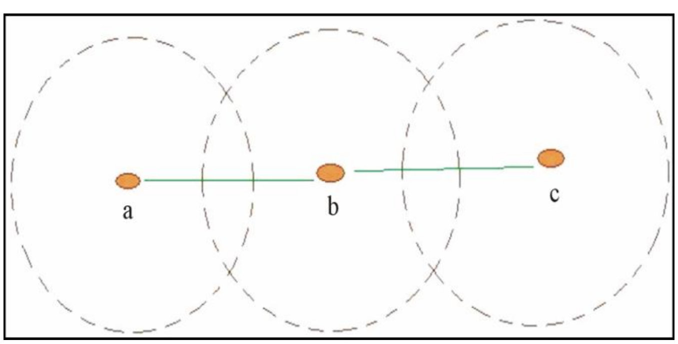

Figure 1. Before links get break

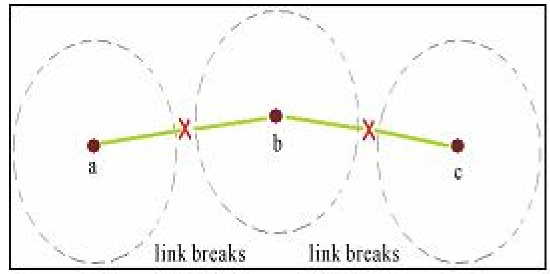

Figure 2. After the links break

After certain duration due to mobility of the node, the get break and the data communication between the nodes are unreliable Figure 2. Working mechanism of URP:

1) Each robust node can arrive at nearby robust nodes directly. When a robust node goes out of a grid, it initiates a robust node election procedure in the grid and a new robust node will be selected.
2) Each Robust node holds a table of node power. Each Robust node can calculate the end-to-end power from itself to any other robust nodes. The node halt time is estimated and updated periodically by each robust node.
3) Incase a source node S needs to setup a route to a destination D. It is considered by the case where the source node S itself is a robust node. In this case, first the robust node S needs to know about the current location of the destination node D. With the information of D's location, S knows about the grid Limit where D stays, and the robust node Limit in the grid.
4) Then S calculates the minimum power between S and network limit by means of the power table, and also discovers the route with the minimum power. If the minimum power is maximum than the required power, then the route cannot be established. The source sensor node generates a unique req_id for each route request. If t_power is less than the max_power, it adds up itself to the route_list, and forwards the REQ packet to the neighbors. If t_power is greater than max_power, the node will drop the REQ packet.
5) If the minimum power between S and network limit is less than the maximum power, sensor node S will notify limit to locate a route to the destination D. Then network limit will up-date the t_power by adding the power between limit and D. If the updated t_power is less than max_power, a valid route is found. Limit will send an ACK (acknowledge) packet to S along the reverse path to ascertain that the route is setup. And every nodes in the route will update its node power. After that S can start sending data.
6) If S is not a Robust node, then S will first discover a path to the nearby Robust node with less power than required. Node S sends out the route request (REQ) packet by flooding to all the sensor nodes in its grid. Only sensor

nodes in the same grid will process and forward the REQ packet. If t_power is larger than max_power, the node will drop the REQ packet. When the Robust node in this grid gets the first request REQ packet, it also updates the t_power and compares it with max_power. If t_power is less than max_power, it will calculate the minimum power between itself and the robust node which is nearest to the destination. The remaining steps are the same as above. In the selected path best path selection is take place to minimize the energy consumption.

7) Sensor node energy level and current location information of robust nodes has to be updated and distributed among all robust nodes. The distribution is done periodically, and the length of the updating period depends on the network dynamics, such as sensor node mobility, sensor network traffic, sensor node data transmission capability, etc.

In the best path selection process[3],Residual energy(RE) is consider in each path and also number of the hops in each path are calculated to rate the path. By considering the min-max condition what are the path is ok for total power consumption, than those path are gone through the best path selection process which path consume less energy than is selected for the data transmission.

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For each valid path P, For every node n in P,

        t_power = power (nl,n)+power(n)

        If t_power >= max_power,delete this path
break,   If t_power<=min_power,delete this path break,

 If t_power>min_power,t_power<max_power,

 than select the path add to table list 1,

best path l= Min_RE(Residual Energy)÷K.(No of hops)

Else add node n to the end of the path

End For   End For
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Pseudo code for URP path selection

V. EMPIRICAL EVALUATION

Figure 3 shows network formation using simulator with 50 nodes includes robust node, sender and receiver also the figure 4 gives the energy update in each nodes at mobility environment. Initially the nodes energy level is 100, according to the data transmissions through each node and the signal range, energy level is get updated.

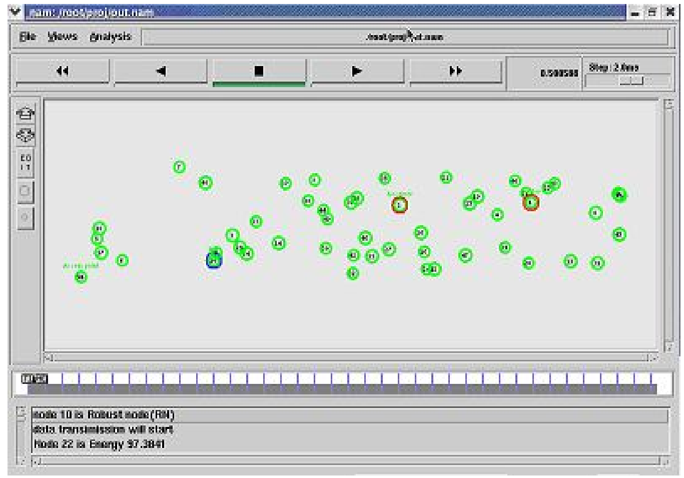

Figure 3.Network Formation

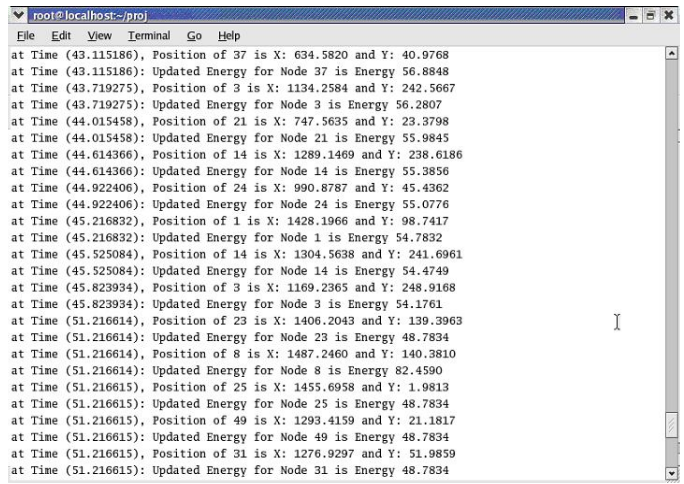

Figure 4.Energy Updates in each node

Figure 5 shows the simulation results Unwavering routing protocol and Power aware routing protocol, energy consumption is reduced in URP compare to PARP, number of active nodes lifetime also increased in URP.

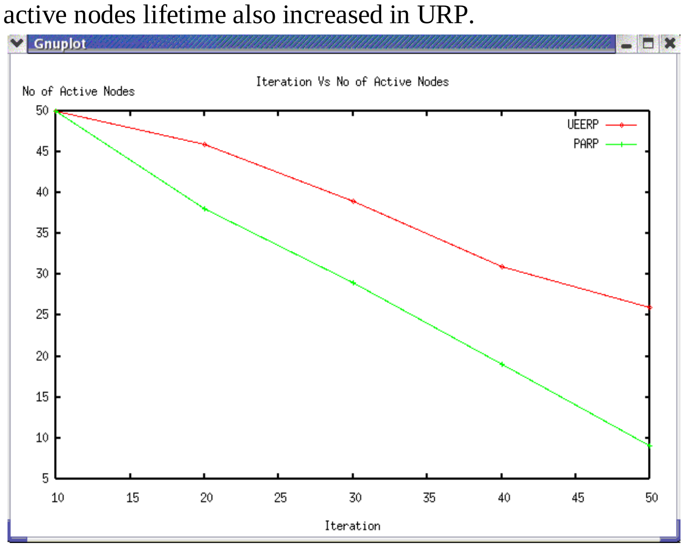

Figure 5.Comparsion Graph

Table 1. Simulation settings

No of nodes	50
Area sizes	1000*1300
Mac	802.11
Radio Range	917 Mhz
Simulation Time	150 sec
Traffic source	CBR
Packet size	150
Mobility Model	Random
Speed	5 ms

VI. CONCLUSION

This paper proposed energy efficient routing protocol for wireless sensor networks. URP uses link quality estimation and energy efficient routing which results in reduced energy consumption and delay with increased packet delivery ratio.

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