I J C T A, 9(2) 2016, pp. 1319-1323

ASDRP: Energy Efficient Autonomous Stratified Dynamic Routing Protocol in Wireless Sensor Network

Pendurthi Sri Venkata Saranya[1] and C. Jothi Kumar[2]

ABSTRACT

Wireless sensor network (WSN) is a system which makes up of a large number of micro-sensors nodes. This network extracts, compute and communicate the data to a base station (BS). Energy is the major constraint of sensor networks. So it's necessary to have which means energy efficient routing protocol should be employed to offer a long-life work time. To accomplish the task, itnot only has to minimize the total energy consumption but also has to balance the load in the network. Analysts put forwarded many protocols such as LEACH, ELCH, and GSTEB. In this paper, we propose an Autonomous Stratified Dynamic Routing Protocol (ASDRP) which builds a routing tree using a process where, for each round, BS assigns a coordinator and broadcasts this selection to all sensor nodes. Subsequently, each node selects its intermediate head by considering only itself and its neighbour's information, thus making ASDRP a dynamic protocol. Simulation results show that ASDRP has shown superior performance than other protocols in stabilizing energy consumption, thus prolonging the lifetime of WSN.

Index Terms: Networklifetime, dynamic routing, autonomous (or) self-organized, wireless sensor network.

I. INTRODUCTION

A main task of WSN is to periodically collect information of the interested area and transmit the information to BS. A simple approach to fulfilling this task is that each sensor node transmits data directly to BS. However, when BS is located far away from the target area, the sensor nodes will die quickly due to much energy consumption. On the other hand, since the distances between each node and BS are different, direct transmission leads to unbalanced energy consumption. To solve these problems, many protocols have been proposed. Of the protocols proposed, hierarchical protocols such as LEACH, ELCH and GSTEB can achieve satisfactory solutions.

The sensor nodes are a small size electronic device. These devices are capable of receiving, processing, and transmitting the amount of data. The communication takes place with their neighbor nodes (i.e., sharing data with their neighbors) and further communicates to the sink. Few applications like military surveillance, environmental monitoring needs a real-time response for further progression. So the sensor network area is one of the most important fields in the academic research. Usually, the wireless sensor node is thrown in hazardous areas where the human can't interrupt. In the case, all the sensor nodes communicate with each other and together form a chain of tree based model. Here, in a tree based model all the node traverse with another node through the neighbor node. Since it is a tree based model, it shares hierarchical network structure. Several routing protocols were introduced to minimize the energy consumption of the node in the network [1].

Energy consumption of a node is based on operations. The operations include transmit-ting or receiving data messages, and processing requests. On the other hand, the energy consumption is due to the operation

[1] M. Tech Student, Computer Science and Engineering, SRM University

[2] Asst Professor, Computer Science and Engineering, SRM University, *E-mail: gamganapathi.saranya2498@gmail.com*

of constructing routing tree, overhearing, retransmitting because of harsh environment, dealing with redundant broadcast over-head messages, and idle listening to the media. In this paper, we propose anAutonomous Stratified Dynamic Routing Protocol (ASDRP). We consider a situation in which the network collects information periodicallywhere each node continually senses the environ-ment and sends the data back to BS.

II. RELATED WORK

In LEACH, for the entire network, nodes selected ac-cording to a fraction p from all sensor nodes are chosen to serve as cluster heads (CHs), where p is a design parameter. Where LEACH is a cluster based routing protocol[2][3]. The op-erations of LEACH are divided into several rounds. Each round includes a setup phase and a steady-state phase. During the setup phase, each node will decide whether to become a CH or not according to a predefined criterion. After CHs are chosen, each of other nodes will select its own CH and join the cluster according to the power of many received broadcast messages. Each node will choose the nearest CH.

During the steady-state phase, CHs fuse the data received from their cluster members and send the fused data to BS by single-hop communication. LEACH uses randomization to rotate CHs for each round in order to evenly distribute the energy consumption. So LEACH can reduce the amount of data directly transmitted to BS and balance WSN load, thus achieving a factor of 8 times improvement compared with direct transmission.

ELCH is an excellent protocol in which each node records the informa-tion of its neighbours and builds topography through computing[4][5], which is similar to ASDRP. But some cluster-heads in the net-work consume more energy than other nodes when BS is located far away.

GSTEB is a tree-based routing protocol that makes all the nodes form a minimum spanning tree, which costs minimum energy for data transmitting. It also has another version called GSTEB which slightly increases energy for data transmit-ting but balances energy consumption per node. However GSTEB are protocols that need BS to build the topography which will cause a large amount of energy waste. The base station computes the received data and identifies the node which has maximum energy is considered as the coordinator[6].This is because if the network needs BS to build the topography, BS should send a lot of information to the sensor nodes, including what time is the Time Division Multiple Ac-cess (TDMA) slot, who are their Child Nodes and who are their intermediate nodes. This kind of information exchanging will cause a lot of energy to be wasted or will cause a long delay.

In this work, we assume that the system model has the fol-lowing properties: **The sensor**nodes are randomly distributed in the square field and there is only one BS deployed far away from the area. Sensor nodes are stationary and energy constrained. Once deployed, they will keep operating until their energy is exhausted. BS is stationary, but BS is not energy constrained. All sensor nodes have power control capabilities; each node can change the power level and communicate with BS directly. Sensor nodes are location-aware. A sensor node can get its location information through other mechanisms such as GPS or position algorithms. Each node has its unique identifier (ID).

III. NETWORK ENERGY MODEL

In this model, the energy dissipation of the radio caused by running the transmitter or receiver circuitry equals E_{elec} = 50 nJ/bit and the energy dissipation of the radio caused by running the transmit amplifier equals $€_{amp}$ = 100 pJ/bit/m^2.It has a randomly distributed 100 to 200 nodes network of square area **50**m x 50m with BS located at 50 m, 120 m. It is also assumed that $a\ r^2$ path loss due to free-space propa-gation model is used. The energy consumption of transmitting a k-bit packet to a distance d and receiving that packet is:

Transmitting: $E_{Tx}(k, \boldsymbol{d}) = E_{elec} x\ k + €_{amp} x\ k\ x\ d^2$

Receiving: $E_{Rx}(k) = E_{elec}\ X\ k$

Where k is a message and d is the distance between the nodes. If all the nodes are assumed to be symmetric, so the energy consumption for node1 to node2 is same as node2 to node1.

IV. ASDRP

Energy Efficient Autonomous Stratified Dynamic Routing Protocol (ASDRP)

The main aim of ASDRP is to achieve a longer network life-time for different applications. In each round, BS assigns a coordinator and broadcasts its ID and its coordinates to all sensor nodes. Then the network computes the path either by sending route information from BS to sensor nodes or by having the same tree structure being dynamically and individually built by each node. For both cases, ASDRP can change the root and reconstruct the routing tree with minimum delay and less energy consumed.

The operation of ASDRP is divided into Stratified Constructing Phase, Autonomous Data Collecting and Trans-mitting Phase.

(A) Stratified Construction Phase (or) Hierarchical Construction Phase

Within each round, GSTEB performs the following steps to build a routing tree. BS assigns a node as root and broadcasts coordinator ID and coordinator to all sensor node in the network. Each node select intermediate node based on the energy level and communicates to the base station through coordinator. Here intermediate node selection is communicated to all the other nodes in the network.The election node which has the less energy (maximum residual energy to withstand) will act as coordinator.Since the entire source nodesenses the data will send n-number of data with n-transmission and the coordinatorcomputes the data received. The computation takes less energy than the transmission. Sothe energy of the coordinator will be less compared to other nodes.

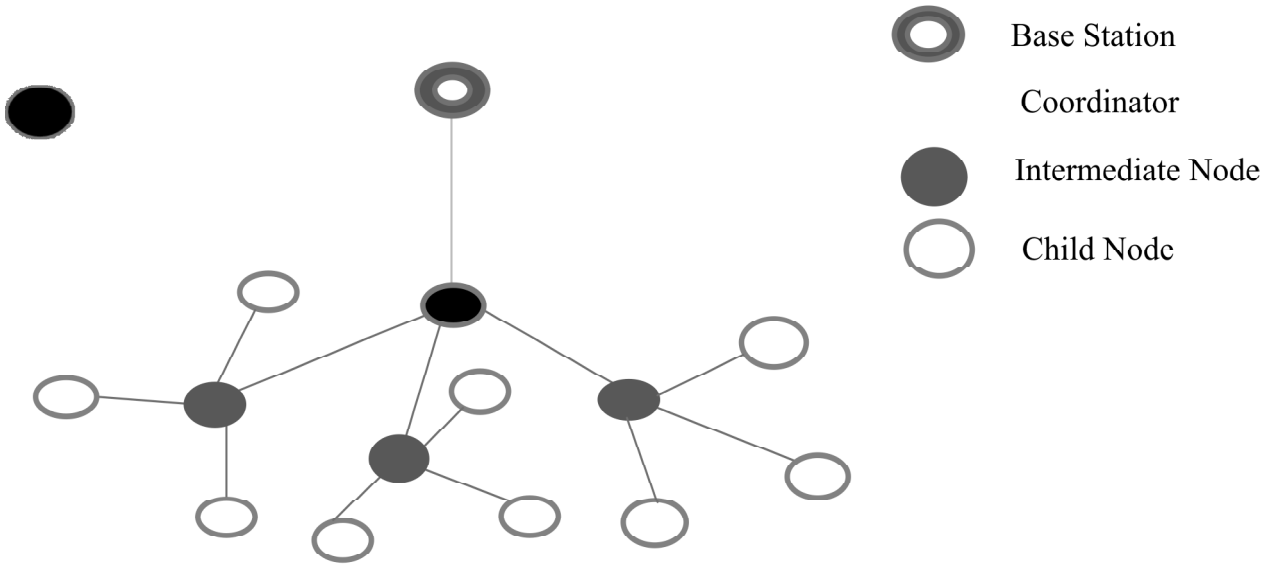


Figure1: Topological representation of ASDRP

(B) Autonomous Data Collecting Phase (or) Self-Organized Data Collecting Phase

After the routing tree is constructed, each sensor node collects information to generate a data which needs to be transmitted to BS.TDMA and DSSS (Direct Sequence Spread Spectrum) are both applied. This phase

is splittedinto several TDMA time slots. In a time slot, only the Child Nodes try to send their data to intermediate node. After a node receives all the data from its Child Nodes, this node itself serves as a Child Node and tries to send the fused data in the next time slot.

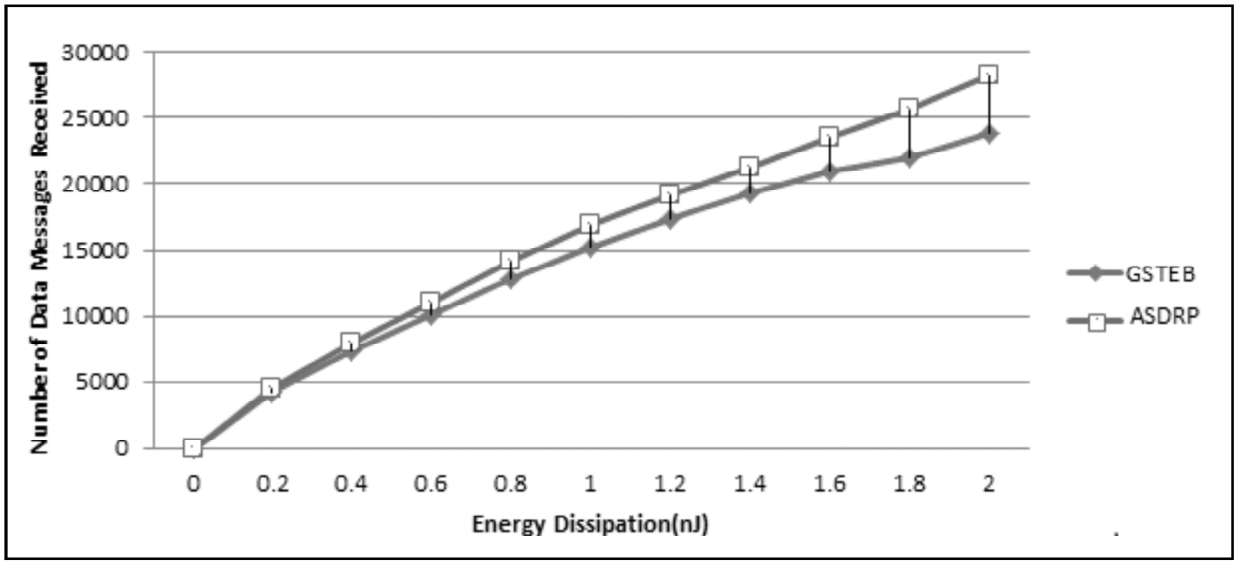
Each node knows their intermediate node. In each time slot, in order to reduce communication interference, we apply DSSS in which each Child Node communicates with its intermediate node using the DSS sequence determined by its intermediate node ID. Based upon the residual energy and energy level, intermediate node and the coordinator changes dynamically. The nodes organized themselves as intermediate node and coordinator based on the energy level and data are collected in each and every level.

(C) Transmission Phase

After self-organized data collection phase data transmission takes place. Each nodes communicate with their intermediate nodes and intermediate node is communicates with the coordinator. i.e. the data packet send form Child Node to intermediate through TDMA schedule and intermediate node send the correlated data to coordinator using DSSS. Finally coordinator sends the aggregated data to the station.

V. COMPARATIVE ANALYSIS AND SIMULATION RESULTS

The simulation model of ASDRP is done to evaluate the performance. It compares GSTEB with ASDRP and use the same network model as GSTEB. We generate a randomly distributed 100 to 200 nodes network of square area **50**m x 50m with BS located at 50 m, 120 m. Where each node has 1J initial energy. As seen, the routing tree generated by ASDRP is better. We use a threshold value for node to act as intermediates. If the threshold value is more than the average then the node will act as intermediate node. In ASDRP, it employs dynamic coordinator that helps to transmit the data to the base station. Here it finds that ASDRP performs much better than GSTEB.



The number of packets, delivered to the energy dissipation is also compared.

VI. CONCLUSION AND FUTURE WORK

In this work, ASDRP is introduced. Two definitions of network lifetime and two extreme cases of data fusion are proposed. Because ASDRP is an autonomous dynamic protocol, it only consumes a small amount of energy in each round to change the topography for the purpose of energy balancing. All the Child Nodes can transmit data in the same TDMA time slot so that the transmitting delay is short. In the proposed

system, the ASDRP shows the energy efficiency protocol comparatively. The lifetime of the node increases, which was shown in the simulation results. The number of packets, delivered in high to the number of rounds and the energy dissipation of the node.ASDRP prolongs the lifetime of the network compared with GSTEB. Since this paper employs low energy nodes as the dynamic coordinator and the node will dead one by one at one period. It can find an alternate solution to increase further the lifetime of the node.

REFERENCES

[1] I. F. Akyildiz *et al.*, "Wireless sensor networks: A survey," *Computer Netw.*, vol. 38, pp. 393^22, Mar. 2002.

[2] Sohrabi *et al.*, "Protocols for self-organization of a wireless sensor network," *IEEE Personal Commun.*,vol.7,no. 5,pp. 16-27,Oct. 2000.

[3] W. R. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "Energy- efficient communication protocols for wireless micro sensor networks," in *Proc. 33rd Hawaii Int. Conf. System Sci.*, Jan. 2000, pp. 3005-3014.

[4] W. B. Heinzelman, A. Chandrakasan, and H. Balakrishanan, "An ap-plication-specific protocol architechture for wireless microsensor net-works," *IEEE Trans. Wireless Commun*, vol. 1, no. 4, pp. 660-670, Oct. 2002.

[5] J. H. Chang and L. Tassiulas, "Energy conserving routing in wirelessad hoc networks," in *Proc. IEEE INFOCOM*, 2000, vol. 1, pp. 22-31.

[6] G. Mankar and S. T. Bodkhe, "Traffic aware energy efficient routing protocol," in *Proc. 3rd ICECT*, 2011, vol. 6, pp. 316-320.