ANALYSIS OF ENERGY EFFICIENCY AND NETWORK LIFETIME IN WIRELESS SENSOR NETWORKS

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Abstract- *Usual wireless sensors are frequently outfitted with small, one-off batteries and hence it is of the greatest value to propose energy efficient algorithms to extend the sensor network lifetime and abridge devices going away to landfill. Sink mobility is a crucial method to get better wireless network performance with good energy utilization, duration and continuous delay. Also, it can fundamentally moderate the hot spots close to the sink node. The lifetime of the network is analyzed by introducing selection of cluster head using an Energy-efficient Algorithm for Fixed Sink (EAFS) and an Energy-efficient Algorithm for Mobile Sink (EAMS).*

Keywords: *Residual Energy, EAFS, EAMS, Cluster Head, Lifetime.*

1. INTRODUCTION

Wireless Sensor Networks (WSNs) are appropriate for the wireless network surroundings suitable to their vital nature including the attributes of self-organizing, infrastructure-less and fault-tolerance. WSNs are generally collection of several sensors and actuators which can sense, process and transmit raw data to a Base Station [2].

Several energy efficient routing algorithms and protocols have been planned to extend network lifetime for WSNs in modern years [3].

Instinctively, the subsequent compensation can be achieved if the mobile sink nodes are well deployed and programmed. Initially, the hot spot trouble can be mostly mitigated when the sink nodes move approximately. Next, energy balancing can be achieved among sensor nodes with extended network lifetime. Third, transmission latency can be condensed and throughput can be enhanced in a multiple sink nodes surroundings. Lastly, a few isolated nodes or data under sparsely deployed networks can be occasionally accessed by mobile sink nodes to develop network performance [5].

The rest of the paper is ordered as follows. Section II focuses on related works pertaining to various sink node exploitation strategies for WSNs. In section III, the proposed algorithms are explained in detail. Section IV concludes the paper.

2. RELATED WORKS

LEACH [1] is one of the most eminent hierarchical routing protocols for WSNs, which can warranty network scalability and lengthen network lifetime up to 8-fold than further common routing protocols. The energy can be fined impartial among sensors because each sensor takes turn to become the cluster head at different rounds. On the other hand, 5% of cluster heads use straight transmission to send their data to the sink node.

In 2003, Shah et al [4] planned the essential idea of mobile sink for WSNs where the authors call them "Data Mules." The Mules use casual walk to pick up data in their secure array and then fall off the data to a little access points. The energy consumption for sensors can be basically compact since the transmission range is small.

The most important intention of this paper is to learn the authority of fixed and mobile sink strategies on wireless network performance in conditions of energy utilization, network life span as well as to moderate the hot spot problem. When fixed sink nodes are deployed, the wireless network is separated into several clusters and the optimal sink number is learned. When mobile sink nodes are deployed, the authority of sink affecting velocity, location and number of sink nodes on wireless network performance is learned [5].

The subsequent assumptions about the system representation are done:

- Wireless links are bi-directional and symmetric
- Sensors are identical and inactive after deployment
- Sink nodes are energy unconstraint and they can move freely
- Great MAC layer with no collisions is supported
- Sensors can alter their power based on the relative distance
- The network is homogeneous

- The nodes in the network are adhoc
- The algorithm is ready at time t
- The clusters are already produced

3. THE PROPOSED ALGORITHMS

In this part, the procedures for election of cluster head are projected. The authority of multiple static and mobile sink nodes on network routine is erudite under unusual scale hierarchical networks. Two sink mobility based energy efficient clustering algorithms for WSNs are projected, namely an Energy-efficient Algorithm for Fixed Sink (EAFS) and an Energy-efficient Algorithm for Mobile Sink (EAMS).

3.1 Method I - Procedure for Election of Cluster Head

Step1: Consider the first sink and cluster assignment of sensor nodes in a network
Step2: Categorize the nodes based on the residual energy (high, medium) to form the current topology of the network.
Step3: Categorize striking set nodes from the beneath system for each cluster.
Step (a): Categorize subsets covering each edge.
Step (b): Achieve intersection operation on each boundary.
Step (c): Set the general element in the strike set.
Step (d): Repeat step (b) and step (c) until all subsets are enclosed.
Step (e): The succeeding set is the striking set.

The nodes in the striking set are the communicating nodes in the network. The lasting nonparticipating nodes in the present topology are sent to sleep mode.
Step4: Categorize the cluster head from each cluster. A set of cluster heads from each cluster forms a hectic set.

3.2 Method II - Procedure for Election of Cluster Head

When the CH collection begins, the sensor node that is positioned in the center of each cluster is forced, like S_i and is regarded as the CH applicant. It contains the node's id and its residual energy. Only the nodes inside the communication range can receive the message and turn into active, whereas the external nodes remain inactive. If any node S_j has better residual energy than S_i, it becomes the new cluster head applicant and broadcasts new message with its own information to the others. If S_j has same residual energy with S_i, compare the ID. The node with a smaller ID wins. If S_j has smaller residual energy than S_i, it still broadcasts the message of S_i. As soon as the comparison is done, the unselected node becomes idle again. All nodes in the cluster should be compared only once. In this way, the node with the largest residual energy is chosen as the cluster head [5].

3.3. Energy-efficient Algorithm for Fixed Sink (EAFS)

The full network is alienated into several clusters, as depicted in Fig.1. In each cluster, there is a Cluster Head (CH) for data collection and the respite of the sensors are called ordinary nodes. The CH is resolute by using those methods among sensors and the CH sends aggregated data to the related sink. By adopting hierarchical routing system, network scalability and easier organization can be assured. If the clustering algorithm is fine planned with CHs situated in a purely extra identical mode, energy expenditure can be fine impartial and condensed, causing a much delayed network lifetime.

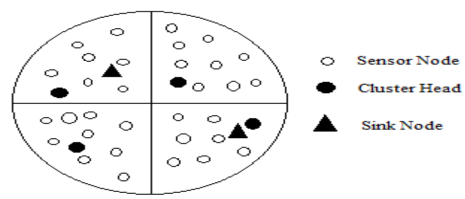

Fig-1: Cluster formation in EAFS

3.4 Energy-efficient Algorithm for Mobile Sink (EAMS)

In EAMS, the moving velocity v of the sink is prearranged. A sink node only wants to broadcast across the network to update all sensor nodes of its present location P_0 at the very opening for just one time. Later on, as sensor nodes keep proof of the unique location of the sink, they can decrease the changed angle θ after a time interval Δt.

After the spreading finishes, the mobile sink is ready to gather data. Here, the mobile sink is implied to wait at a site for a period long enough for data collection, and then moves to the next location. As depicted in Fig.2, the entire sensor network is separated into several clusters.

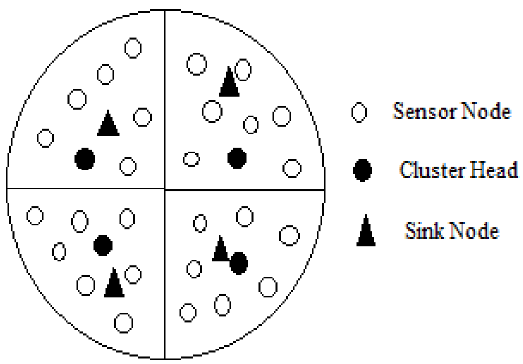

Fig-2: Cluster formation in EAMS

In EAMS, the sink node changes its position over time. So, some nodes may consume less energy during sending data frankly to the sink node pretty than its Cluster Head.

4. SIMULATION RESULTS

From Fig.3 and Fig.4, it can be seen that the cluster head selection method II has much better performance than the cluster head selection I in terms of total residual energy and number of nodes alive. In Fig.3, the total residual energy of EAMS CH selection method I decrease more sharply than EAMS CH selection method II. If network lifetime is defined as the time when the first node dies out of energy, the lifetime of EAMS CH selection method II is two times longer than EAMS CH selection method I in Fig.4.

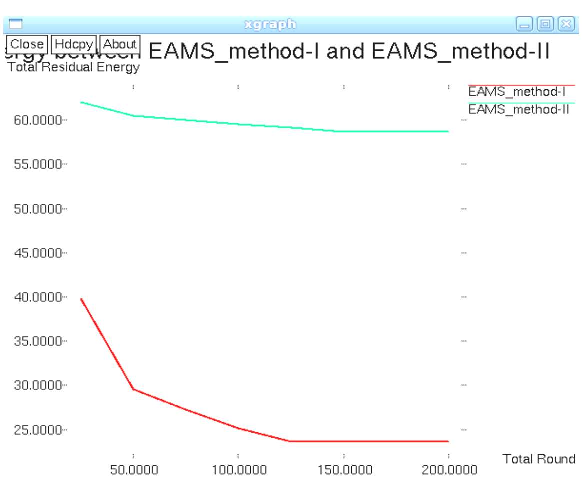

Fig-3: Total residual energy between CH method I & method II in EAMS

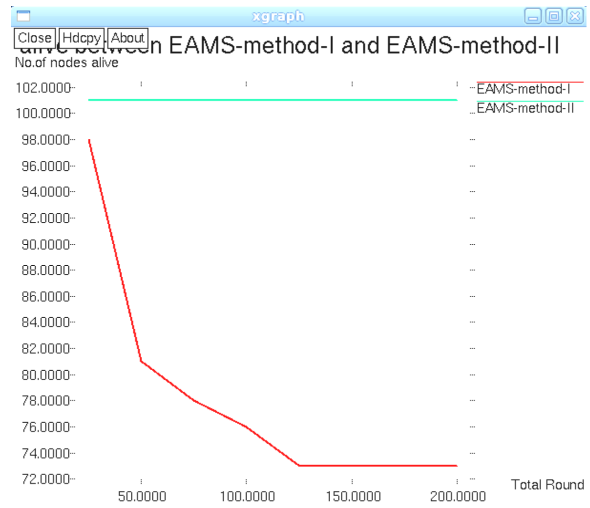

Fig-4: Number of nodes alive between CH method I & method II in EAMS

5. CONCLUSION

Sink mobility has an extremely important contact on the network management, particularly for a wireless network or networks without a fixed communications. In this paper, two sink mobility based energy efficient clustering algorithm are proposed for WSNs, namely EAFS and EAMS. These algorithms improve the network performance and lifetime if we use CH method II.

REFERENCES

[1] W. R. Heinzelman, A. Chandrakasan, H. Balakrishnan, *"Energy-efficient communication protocol for wireless microsensor networks,"* Proc. of the 33rd Annual Hawaii International Conference on System Sciences (HICSS), pp. 1-10, Jan. 2000.

[2] I. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey," *Journal of Computer Networks*, *vol. 38*, no. 4, pp. 393-422, March 2002.

[3] K. Akkaya, M. Younis, "A survey on routing protocols in wireless sensor networks," *Elsevier Ad Hoc Network Journal*, *vol. 3*, no. 3, pp. 325-349, May 2005.

[4] K. Akkaya, M. Younis, M. Bangad, "Sink repositioning for enhanced performance in wireless sensor networks," *Elsevier Computer Networks, vol. 49*, no. 4, pp. 512-534, Nov. 2005.

[5] Jin Wang, Yue Yin, Jianwei Zhang, Sungyoung Lee, R. Simon Sherratt, "Mobility based energy efficient

and multi-sink algorithms for consumer home networks," *IEEE Transactions on Consumer Electronics,* vol. 59, no. 1, pp. 77-84, February 2013.

BIOGRAPHIES

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