International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.03, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Analysis of Cluster based Routing Algorithms in Wireless Sensor Networks using NS2 simulator

Ashika R. Naik

Department of Electronics & Tele-communication, Goa College of Engineering (India)

ABSTRACT

Wireless sensor networks (WSNs) are employed in various applications including area monitoring, health care monitoring, industries etc. They consist of sensor nodes varying from few hundreds to thousands and one or more base stations. Sensor nodes performs the function of monitoring and recording the physical conditions of the environment and organizing the collected data at a central location. Since the sensor nodes may be located far from the base station, energy consumption may increase in such situation.

In this paper, we aim to analyze the cluster-based routing algorithms which will reduce the energy consumption in sensor networks and hence will increase the lifespan of WSN. Routing algorithms are classified as flat, hierarchical and location-based. Cluster based routing algorithms are found to be more efficient compared to other routing algorithms.

Keywords–cluster head, energy, hierarchical, routing, wireless sensor networks.

I. INTRODUCTION

A WSN is a wireless sensor network consisting of large number of sensor nodes which sense various parameters like temperature, humidity, pressure etc. and one or more base station(s). Sensor nodes process the sensed parameters and then forwards this data either directly to base station or via intermediate sensor nodes. These nodes have limited power supply, communication range, memory etc. and hence over a long period, energy of these nodes may degrade completely and nodes may die out. This can affect the overall communication process in the sensor networks.

Many routing algorithms have been proposed for analyzing the wireless sensor networks. Categories of WSNs include flat, hierarchical and location-based routing algorithms. Flat routing includes algorithms like DSDV, AODV, DSR, OLSR etc. Here, all the nodes in the network performs the same role. In hierarchical routing, network is divided into many clusters and a cluster head is selected in each cluster. All the nodes which are far away from base station in the network forward its data to the base station via cluster head. This greatly helps in reducing the energy consumption of the nodes.

In few of the proposed hierarchical algorithms, cluster head is selected randomly. However, if the cluster head is selected which is having the least energy, this may further affect the network performance in WSN. Hence, routing algorithms should be selected considering all these facts.

In this paper, we aim to analyze cluster-based routing algorithms since they are found to have better energy efficiency compared to flat routing. Selecting a cluster head in a manner which have the highest energy within that cluster will help to further increase the network lifetime.

II. HIERARCHICAL ROUTING PROTOCOLS

In this paper, we have carried out cluster-based routing analysis using ns2 simulator. In cluster-based approach for energy efficient routing in WSNs, network is divided into groups of sensor nodes called clusters and within each cluster, a cluster head is selected which receives the data from all the nodes within that cluster and forwards the data to the base station. There are many hierarchical algorithms proposed to improve the overall energy of the wireless sensor networks, some of which are LEACH, PEGASIS, APTEEN, TEEN etc.

LEACH stands for Low Energy Adaptive Clustering Hierarchy protocol. In this, a sensor network is divided into groups of nodes called clusters. It utilizes randomized rotation of local cluster-based stations (cluster heads) to evenly distribute the energy load among the sensors in the network. LEACH uses localized coordination to enable scalability and robustness for dynamic networks and incorporates data fusion into the routing protocol to reduce the amount of information that must be transmitted to the base station. In a100 nodes scenario, LEACH protocol was implemented with each sensor node sending a 2000-bit data packet to the base station during each round. After energy level of node reached a threshold set, that node was considered as a dead node for the rest of the simulation time. However, problems with LEACH protocol is that cluster-heads are selected randomly, and hence each node has equal probability to become a cluster-head. Also, within clusters, single hop routing is being employed.

PEGASIS stands for Power Efficient Gathering in Sensor Information Systems. It is a chain-based protocol. It is data gathering algorithm which establishes the design that energy consumption can occur from nodes not directly forming clusters. Sensor nodes in wireless networks are organized to form chain that can either be concentrated by sink or terminated themselves by a greedy algorithm. This protocol performs better than LEACH but it has demerits of its delay which is because of the formation of chains to forward its data.

TEEN (Threshold sensitive Energy Efficient sensor Networks) is also a hierarchical routing protocol. The aim of this protocol is to address problem like sudden changes in the sensed parameters like pressure, temperature etc. There are two thresholds defined one is hard threshold and other is soft threshold. Hard threshold for the sensed attribute in which cluster member sends/reports data to the cluster-head only if data values are in the scope of interest. Whereas soft threshold is used when there is small change in the sensed attribute.

APTEEN (Adaptive Threshold sensitive Energy Efficient sensor Networks) is expansion over TEEN protocol. It is based on a query system which include three types of queries viz historical, on-time and constant which can be used in a hybrid network. It outperforms traditional LEACH in terms of energy, however, it has limitations due to its overhead and complexity.

III. WORKING OF LEACH PROTOCOL

Operation of LEACH Protocol: LEACH operation is divided into rounds, with each round having set-up and steady- state phase. In the set-up phase, each node decides whether or not to become a cluster-head for the current rounds. This decision was made by the node n choosing a random number between 0 and 1. If the number is less than a threshold T(n), the node become a cluster-head for that current round. And the threshold was set as:

$$T(n) = \begin{cases} \dfrac{p}{1 - p * (r \bmod \frac{1}{p}),} & \text{if } n \in G \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

Where r indicates the current round, p is the probability with which node can be selected as a cluster-head. G is a set of nodes which has not become cluster-head till current round.

The Phases of LEACH protocols are explained as follows:

Set-up phase: includes cluster-head advertisements and scheduling sensor nodes within each cluster by respective cluster head.

Steady-state phase: involves transmission of data (packets) between nodes at scheduled time intervals.

If node has become a cluster-head once, it can become a cluster-head again until all other nodes in the network has become cluster-heads. This helps in balancing the energy consumption in the network. As mentioned earlier, in steady-state phase, data transmission occurs. The cluster-head then aggregates all the data collected from all the members within that cluster and forwards it directly to the base station or via other cluster-heads in the network. Cluster-head should therefore have sufficient energy.

IV. SIMULATION AND RESULTS

In this paper, we have simulated cluster-based routing environment for wireless sensor networks using ns2 simulator (ns-2.35).

In order to carry out simulation, few assumptions have been made which are listed as below:

- All nodes have same initial energy level.
- Nodes are assumed to have sufficient transmission range.

In our simulation, nodes are mobile at few instants of the simulation time. Clusters of nodes are formed and a cluster head is selected within each cluster.

International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.03, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

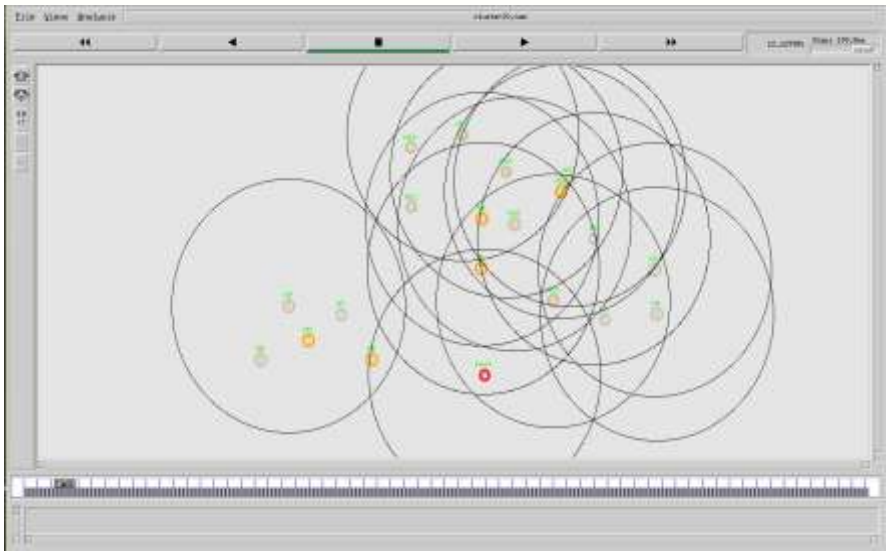

Figure 1: NAM window showing sensor node scenario in wireless network

Fig. 1 above shows the NAM window which appears during simulation using ns2.35. It shows the sensor nodes scenario created in wireless network, and how nodes are sensing each other in the network. Node 15 is set as a base station. In fig. above, new clusters are formed as nodes moves.

Fig. 2 below depicts the trace file output for the sensor nodes created in fig.1. It shows at what instant of time, packets are sent, received or dropped, which nodes are sending or receiving data packets, energy of nodes etc. The trace format is as follows: s implies packet is sent, r implies packet is received. Following this, is the simulation time, node number.

"ei" indicates energy when node is idle i.e 0 joules, "e_r" and "e_t" indicated energies for receiving and transmitting data respectively.

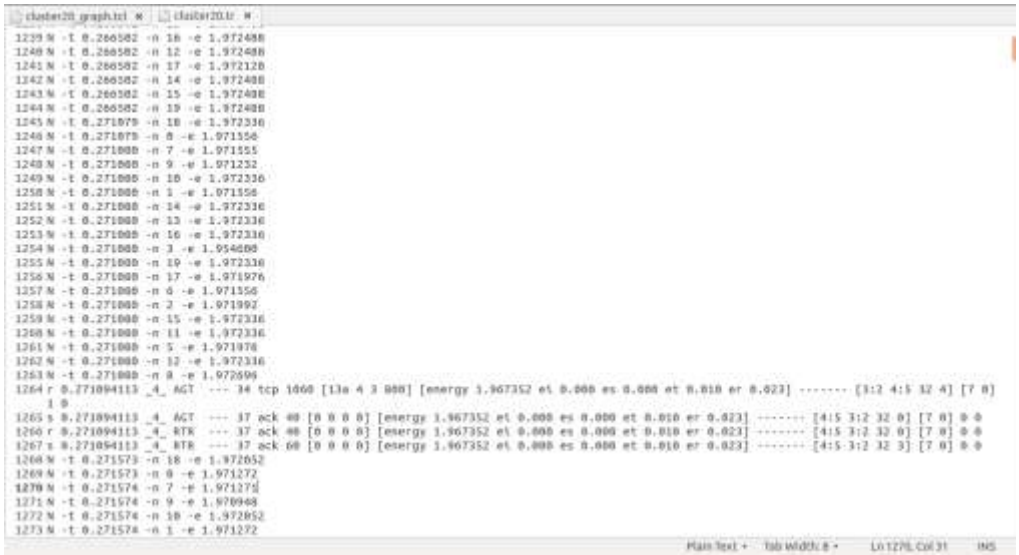

Figure 2: Trace file generated for sensor network

Table. 1. Simulation Environment Parameters

Simulation Area	1000x1000
Simulation Time	250 seconds
Initial energy of node	2Joules
Channel Type	Channel/wireless channel
Radio propagation model	Two ray ground

V. CONCLUSION

Routing in wireless sensor network is a great area of interest in today's world. Efficient routing of sensor nodes in wireless networks not only makes it robust but also improve the network lifetime. In this paper, we have tried to analyze the cluster-based routing techniques to build energy efficient wireless sensor networks. Hierarchical based routing approach is found to be much better than flat routing approach due to clustering used in this routing techniques. Routing can be done for both, static as well as moving node scenario.

In the paper, we have carried out simulation using network simulator (ns-2.35). Wireless sensor network can be analyzed in terms of throughput, delay etc. However, we have focus more on energy improvement of network using clustering approach which in turn will improve the lifetime of wireless sensor networks. Firstly, advantages and disadvantages of various routing protocols have been listed. Following these, analysis of cluster-based routing techniques were presented.

VI. ACKNOWLEDGEMENTS

I am grateful to my guide, Prof. Sonia Kuwelkar, assistant professor at Goa college of engineering, for her constant guidance and support in my project work. I am also thankful to my parents and friends for their motivation in my work.

REFERENCES

[1] Hierarchical based Routing Protocol in WSN, *International Journal of Computer Applications (0975 – 8887) Next Generation Technologies for e-Business, e-Education and e-Society (NGTBES-2016)*

[2] Energy andThroughput Analysis of Hierarchical Routing Protocol (LEACH) For Wireless Sensor Network, *International Journal of Computer Applications (0975 – 8887)Volume 20– No.4, April 2011*

[3] Wireless Sensor Network Architecture *2012 International Conference on Computer Networks and Communication Systems (CNCS 2012) IPCSIT vol.35(2012) © (2012) IACSIT Press, Singapore.*

[4] Kazem Sohraby, Daniel Minoli And TaiebZnati,*Wireless sensor networks-Technology, Protocols, and Applications* (Wiley Inter-science-A John Wiley & Sons, Inc., Publication, Hoboken, New Jersey)

[6] *Protocols and Architectures for Wireless Sensor Networks.* Holger Karl and Andreas Willig Copyright 2005 John Wiley & Sons, Ltd. ISBN: 0-470-09510-5

[5] Tutorial for Network Simulator "ns" by Mark Greis.nsusers@isi.edu

[6] A typical Hierarchical Routing Protocols for Wireless Sensor Networks: A Review, IEEE SENSORS JOURNAL, VOL. 15, NO. 10, OCTOBER 2015 by Xuxun Liu, *Member, IEEE.*

[7] W. Heinzelman, A. Chandrakasan and H. Balakrishnan, "Energy-Efficient Communication Protocol for Wireless Microsensor Networks," Proceedings of the 33rd Hawaii International Conference on System Sciences (HICSS '00), January 2000.