DEAD NODE DETECTION IN TEEN PROTOCOL: SURVEY

Avani Patel[1], Chandresh R. Parekh[2]

[1]*Department of Wireless and Mobile Computing, GTU PG-School, BISAG, Gandhinagar, India*
[2]*Department of Electronics and Communication, Government Engineering College-Sector 28, Gandhinagar, India*

Abstract

Now a day's wireless sensor network has become an interesting research field. Network life time and energy efficiency are one of the main concerns for wireless sensor networks. Sensors are constrained in terms of battery power, storage, limited processing capacity etc. Because of these reasons new protocols are proposed for wireless sensor network. This paper only deals with cluster based hierarchical protocol TEEN (Threshold Sensitive Energy Efficient Sensor Network Protocol). The sensor network architecture in TEEN is based on a hierarchical clustering. TEEN is data-centric, reactive, event-driven protocol which is best suited for time critical application. It transmits data based on hard threshold and soft threshold values. If the thresholds are not reached, then nodes will never communicate. The user will not get any data from network and will not come to know if all the nodes die. So, user will not be able to distinguish between how many nodes are alive or dead in network and will not be able to know about network lifetime. This paper deals with that node will be able to tell base station or sink before leaving network and base station will be aware of alive and dead nodes in the network.

Keywords: *WSN; TEEN (Threshold Sensitive Energy Efficient Clustering); Hard Threshold; Soft Threshold;*

----------***----------

1. INTRODUCTION

Now a day's Wireless sensor networks became an interested research field because it has been considered as the most important technologies. WSNs have many unique characteristics such as denser level of node deployment, unreliability of sensor nodes is high, and energy constrains, computation, and storage constraints. This characteristics brings out new challenges in applications and development of WSNs. In WSN mainly radio transmission and reception consumes a lot of energy, which is an important issues as nodes have limited battery power within network WSN consists of a large number of low-cost, low-power, and small sized sensor nodes that are deployed in a region of interest. Sensor nodes have several parts microprocessors, radio transceivers, circuit and battery to enable sensing, computing, communication, and actuation.

In WSN nodes are self-organizing, they often have multi-hop connections between sensor nodes. The sensors collect information in two modes either event driven or continuous.

Routing in WSN is different and very challenging from routing in traditional wireless ad hoc networks due to many constrains like transmission power, energy, processing capacity and storage as sensor node require careful resource management. A variety of protocols were proposed for fulfilling this requirements and prolonging the life of network and for routing the correct data to the base station.

1.1 Clustering in WSN

In terms of energy consumption, traditional routing protocols for WSN may not be very optimal. Clustering provides scalability; better network lifetime and it reduce energy consumption.

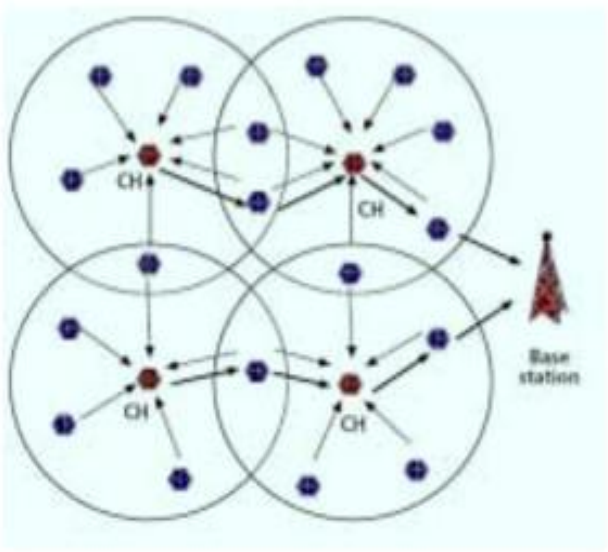

Fig 1 Clustering of Sensor Nodes [2]

As shown in figure 1 Cluster consists of a group of sensor nodes and also known as clump. There is a special node which leads or manages a cluster is called as cluster head and it also responsible for coordination and data transmission in cluster as

it act as local coordinator or sink for that cluster. Cluster head aggregates the data and send it to the base station. Clustering provides a load balancing among the nodes and improves the network lifetime. Clustering reduces routing overhead and network appears small in size and more stable.

Clusters have ability to use different power levels in inter-cluster and intra cluster communication which reduce the interference and collision in network [6].

1.2 Cluster-Based Hierarchical Model

Hierarchical approach provides data fusion and aggregation that leads to a significance energy saving. As shown in Figure 2, in this approach network breaks down into cluster layers. CH aggregates data, this data travels from a lower clustered layer to a higher one and eventually reached to the base station. Using this approach node covers larger distance and data moves faster to the base station and by doing so they reduce travel time and latency.

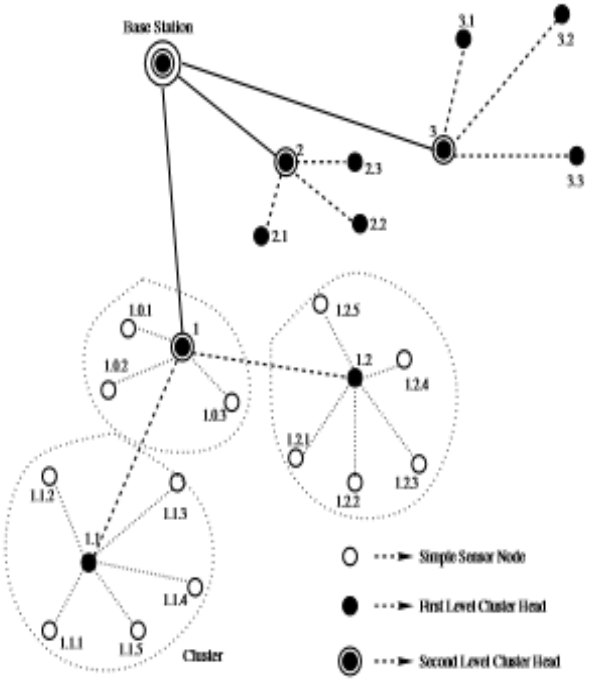

Fig 2 Cluster-based Hierarchical Model [2]

A cluster-based hierarchical model offers an efficient way for lower energy consumption in cluster, scalability, decrease the number of transmission to the base station. LEACH, PEGASIS, TEEN, APTEEN, HEED, etc. are the representative protocols for hierarchical clustering.

2. TEEN (THRESHOLD SENSITIVE ENERGY EFFICIENT SENSOR NETWORK PROTOCOL)

The first protocol developed for reactive networks is TEEN (Threshold sensitive Energy Efficient sensor Network protocol). TEEN is based on cluster based hierarchical approach and uses data centric method. TEEN is event-driven, reactive protocol which is best suited for time critical application. It transmit data based on hard threshold and soft threshold values as it uses data centric approach in which data is crucial and requested based on attribute value.

The application of this protocol such as intrusion detection, explosion detection etc

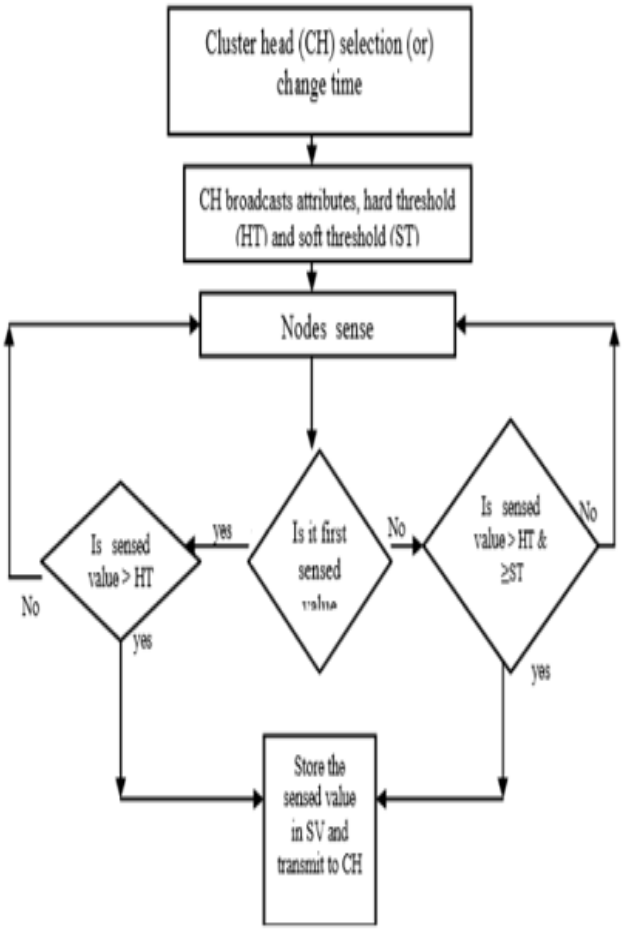

Fig 3 Operation Flow Chart of TEEN [8]

In TEEN protocol cluster head formation process is based on LEACH (Low Energy Adaptive clustering in Hierarchy). First the clusters are formed, and then CH broadcasts two thresholds to the all member nodes: hard threshold (HT), and soft threshold (ST). At every cluster change time this two attributes are also broadcast by CH.

The functioning of TEEN is,

- Hard threshold (HT): This is a threshold value for the sensed attribute. It is the absolute value of the attribute beyond which, the node sensing this value must switch on its transmitter and report to its cluster head. [2]
- Soft Threshold (ST): This is a small change in the value of the sensed attribute which triggers the node to switch on its transmitter and transmit. [2]

As it says in definition, only when the sensed attribute is in the range of interest the hard threshold allows the nodes to transmit data and by doing so they reduce the number of transmissions significantly.

Soft Threshold also significantly further reduce the number of transmission of sensed data as it eliminates data transmission if there is little or no change in the sensed attribute.

In this approach, based on the end user's interest the sensor nodes will only transmits data based on hard threshold value and soft threshold value which leads to the more energy savings. These two attribute values can be adjusted in order to control number of data packet transmission.

3. SURVEY

As mentioned above TEEN is data centric, event driven and energy efficient protocol but there are some drawbacks in this scheme. The summery of this drawback is as follows:

3.1 A Survey of Energy Efficient Hierarchical Cluster Based Routing in Wireless Sensor Network [1]

As authors of this paper Shio Kumar Singh, M P Singh, D K Singh have mentioned in their paper that energy consumption in this approach is less than the proactive network as message transmission consumes more energy than data sensing. In opposed, in reactive network only if there is an event than nodes will turn on their transmission mode and send data to the base station

Authors have mentioned that TEEN is responsive protocol so it is not suitable for sensing application and where nodes have to report periodically because if thresholds are not reached then user may not get any data.

3.2 TEEN: A Routing Protocol for Enhanced Efficiency in Wireless Sensor Networks [2]

Authors of this paper Arati Manjeshwar and Dharma P. Agrawal have mentioned that the nodes will transmit data to their respective cluster head in, only when both the following conditions are true:

1. The current value of the sensed attribute is greater than the hard threshold.

2. The current value of the sensed attribute differs from Sensed Value (SV) by an amount equal to or greater than the soft threshold.

Authors have also mentioned drawbacks of this scheme which are, when there is a matter of practical implementation of TEEN there must be no collision in the cluster. To avoid the collision problem TDMA scheduling of the nodes can be used but it also introduces a delay in reporting time critical data to the base station and if sensed attribute never reached to the hard threshold there will be no communication between base station and user and user will not be able to know if all the node dies.

3.3 HEER: Hybrid Energy Efficient Reactive Protocol for Wireless Sensor Network [3]

The authors of this paper N. Javaid, S. N. Mohammad, K. Latif, U. Qasim and Z. A. Khan, M. A. Khan have mentioned the issue of remaining energy. They have said that TEEN is a reactive protocol which in homogeneous environment, guaranties that there will be a short unstable region. They also mentioned that after the death of the first node, all the other remaining nodes are expected to die on average within a small number of rounds. In this scheme energy consumption is well distributed and due to this there are consequences of uniform remaining energy that causes the death of other nodes in network and also because all nodes have same probability to become cluster head.

As opposed to that TEEN in the presence of high energy nodes yields a large unstable region. The reason behind that is, all high energy nodes are equipped with almost the same energy and due to that, the CH selection process is unstable and as a result most of the time these nodes are idle, as there is no CH to transmit.

3.4 A Survey of Hierarchical Routing Protocol in Wireless Sensor Network [4]

This paper states that there is always a possibility that the sink may not be able to distinguish dead nodes from alive ones. This is a drawback of this protocol. Author also states that in this protocol the message propagation is accomplished by CHs only. If CHs are not in each other's transmission range, the messages will be lost.

The authors have also mentioned that the value of soft threshold can be varied but it depends on the criticality of the sensed attribute and the target application. A smaller value of the soft threshold gives a more accurate picture of the network, but it also increased energy consumption. Thus, the user can control the trade-off between energy efficiency and accuracy.

4. PROBLEM STATEMENT AND PROPOSED SOLUTION

4.1 Problem Statement

As mentioned in papers, TEEN transmit sensed attribute value to the base station based on hard threshold and soft threshold values manually set by user. Above mentioned papers states that there are some drawbacks in TEEN but mainly the drawback is if the thresholds are not reached, then nodes will never communicate. The user will not get any data from network and will not come to know if all the nodes die. So, user will not be able to distinguish between how many nodes are alive or dead in network and will not be able to know about network lifetime[1][2][3][4][5][8].

4.2 Proposed Solution

As mentioned in all papers above, In TEEN protocol, main problem is not knowing when the nodes in network will die and user won't be able to get network information from network.

So, this is a proposed solution in which, node will send message to the base station about its energy level status. And for that proposed algorithm for nodes in the network is as follows.

For This algorithm the assumptions are that nodes in the network are static, and this algorithm is for small networks. This algorithm is for homogeneous network and at initial level of network all nodes are having same energy.

The steps of proposed algorithm:

- At initial level of network all nodes are having same energy.
- When node's energy level is drained up to its 60% level, and if sensed attribute value is never reached to thresholds then node will send its energy level status message indicating 60% energy level to the base station. Or instead, if sensed attribute value reached to the thresholds then node will store the sensed value and send it to the base station along with the current energy level status of battery in the same frame.
- Above step is repeated for energy level of 60% to 40%, 40% to 20% and as well as for 20% to 5%.
- When node's energy level is drained up to 5%, node will send its energy status message to the base station whether there was an event occurred or not.

According to this algorithm, there are four predefined levels 60%, 40%, 20%, 5% at which node will send its energy level status message indicating its energy level to the base station.
But in this algorithm first importance is given to event as this is an event driven protocol. So, when there is an event occurred near before nodes predefined energy level status then that status message is ignored (is not sent to the base station) and instead sensed attribute value is sent to the base station along with the battery's current energy level status. So, it will lessen the overhead.

At 5% of energy level whether there was an event occurred or not in node's life time, node will send its energy level status to the base station indicating it is 5%. Thus, base station will come to know soon node's battery will completely drain and node will leave network.

By sending battery's energy level status messages to the base station, user will be aware of node's lifetime in the network.

5. CONCLUSIONS

The wireless sensor network is an active research area constantly due to their promising development and wide area of applications. The main concerns in WSNs are energy and network life time and there are many protocols introduce to overcome these concerns. TEEN is energy efficient protocol which also prolong the network life time. But there is drawback of this protocol that if threshold is not reached then there will be no communication and user will not come to know about dead nodes of network or all the nodes are dead in network. And I have proposed the solution in which node will send their energy status to the base station to overcome the problem of user not knowing about dead node of network and can be aware of network life time.

ACKNOWLEDGMENTS

I would like to thank my guide, Prof. Chandresh R. Parekh for his patient guidance and valuable and constructive suggestions. I would also like to thank my friends and family for their valuable suggestions and support.

REFERENCES

[1] Shio Kumar Singh, M P Singh, D K Singh,"A Survey of Energy-Efficient Hierarchical Cluster-Based Routing in Wireless Sensor Networks" Int. J. of Advanced Networking and Applications Volume: 02, Issue: 02, Pages: 570-580 (2010)

[2] Arati Manjeshwar and Dharma P. Agrawal, "TEEN: A Routing Protocol for Enhanced Efficiency in Wireless Sensor Networks", Center for Distributed and Mobile Computing, ECECS Department, University of Cincinnati, Cincinnati, OH 45221-0030

[3] N. Javaid, S. N. Mohammad, K. Latif, U. Qasim, Z. A. Khan, M. A. Khan, "HEER: Hybrid Energy Efficient Reactive Protocol for Wireless Sensor Networks" COMSATS Institute of Information Technology, Islamabad, Pakistan. Faculty of Engineering, Dalhousie University, Halifax, Canada. University of Alberta, Alberta, Canada.

[4] Ankita Joshi , Lakshmi Priya.M, ”A Survey of Hierarchical Routing Protocols in Wireless Sensor Network”, Department of Computer Science and Engineering, NIT Hamirpur, Himachal Pradesh, India

[5] Tintu Devasia, Gopika S,”Statistical Analysis of Energy Efficient Hierarchical Routing Protocols in WSN” International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 5, May 2013

[6] R.A.Roseline1, P.Sumathe,” Local Clustering and Threshold Sensitive routing algorithm for Wireless Sensor Networks”

[7] Zibouda Aliouat Saad,” An Efficient Clustering Protocol Increasing Wireless Sensor Networks Life Time” 2012 International Conference on Innovations in Information Technology (IIT)

[8] Abid Ali Minhas, Fazl-e-Hadi, Danish Sattar, KashifMustaq and S. Ali Rizvi,”Energy Efficient Multicast Routing Protocols for Wireless Sensor Networks”Department of Graduate Studies and Applied Sciences Bahria University, Islamabad, Pakistan