International Journal of Scientific Engineering and Technology Research

ISSN 2319-8885
Vol.06,Issue.25
July-2017,
Pages:4815-4818

www.ijsetr.com

# Threshold Sensitive Distributed Energy Efficient Clustering Routing Protocol for Wireless Sensor Networks

**P. HARI PRASAD[1], E. GOVINDA[2], KUNA DILLI[3]**

[1]PG Scholar, Avanthi Institute of Engineering & Technology, Tamarm, Vishakhapatnam(Dt), AP, India, Email: paluruhariprasad@gmail.com.

[2]Assistant Professor, Avanthi Institute of Engineering & Technology, Tamarm, Vishakhapatnam(Dt), AP, India, Email; ennamgovinda19@gmail.com.

[3]Assistant Professor, Avanthi Institute of Engineering & Technology, Tamarm, Vishakhapatnam(Dt), AP, India, Email; dhilivista072@gmail.com.

**Abstract:** Wireless sensor networks consist of small battery powered devices with limited energy resources. Once deployed, the small sensor nodes are usually inaccessible to the user, and thus replacement of the energy source is not feasible. WSN must operate without human involvement. Hence, energy efficiency is a key design issue that needs to be enhanced in order to improve the life span of the network. Several network layer protocols have been proposed to improve the effective lifetime of a network with a limited energy supply. The network lifetime can be increased with the introduction of the heterogeneity in sensor nodes. The proposed is a hybrid routing protocol: TDEEC (Threshold Sensitive Distributed Energy Efficient Clustering) protocol for heterogeneous WSNs. We implemented TDEEC and compared it several protocols like LEACH, SEP and Z-SEP. Simulation results showed that TDEEC enhanced the stability period and throughput than existing protocols like LEACH, SEP and Z-SEP.

**Keywords:** Wireless Sensor Network, Routing Protocol, Network Lifetime, Clustering.

## I. INTRODUCTION

Wireless Sensor Network (WSN) is a kind of self-configuring network composed of a set of wireless sensor nodes also called motes . The lifetime of WSN is limited because the sensor node works on battery life and it is hard to recharge the battery at regular basis because of the deployment of wireless sensor network in remote and hostile places. The energy cost is more in term of transmission of data than processing data. In order to prolong the network lifetime, a network routing protocol with high energy efficiency is necessary besides designing low-power sensor nodes. A current research challenge is to develop low-power communication with low-cost on-node processing and self-organized connectivity/protocols. Several protocols were developed to make the communication energy-effective to prolong the life of the networks. These protocols were different in how they improve the communication and transmission of the packets in the network but they all based on clustering approach in the network. The homogeneous protocol(due to same initial energies of all nodes) LEACH[1] which considered all nodes of same energy used the probabilistic approach to elect the cluster head and the probability of choosing the cluster head decides after how many rounds a node can be again cluster head. But this approach does not guarantee for a high energy node to be cluster head.

PEGASIS [2] was proposed to do cluster-free routing. In this sensor nodes form a chain, they transmits and receives data from a neighbor, neighbor node is selected on the basis of energy status and only one from that chain transmit data to the base station. In this a sensor node should know the energy status of its neighbors in order to route its data, such topology adjustment can introduce significant overhead for highly utilized networks. After these homogenous, a heterogeneous protocol came, SEP [3] which divided the network into two types of nodes having different energy normal and advanced nodes. The probabilistic method of selecting the cluster heads is different for these two types of nodes. These probabilities are based on their energies. This was done to improve the stability period (the time when first node dies) of the network and to extend the life. Several enhanced versions of SEP routing schemes were proposed such as ESEP, ZSEP etc. ESEP[4] increase the heterogeneity to level 3 using the normal, intermediate and advanced nodes and these were taken in the order of increasing initial energies resp. ZSEP divided the network in the form of zones which resemble clusters so that proper distribution of the nodes and energies in each cluster can be done These successfully outperformed the SEP but shortcoming of these protocols including SEP of not considering the effect of residual energies on the cluster head selection probabilities for different kind of nodes.

Another Protocol, DEEC [5] took the concept of residual energy and average energy of the network in electing the cluster heads with existing heterogeneity of the nodes and successfully improved the routing in network. Several versions of DEEC were explored which improved it further such as DDEEC and EDEEC. DDEEC [6] uses same method for estimation of average energy in the network and CH selection algorithm based on residual energy as used in DEEC. DDEEC introduces threshold residual energy and when energy level of advanced and normal nodes falls down to the limit of threshold residual energy then both type (normal and advanced) of nodes use same probability to become cluster head. EDEEC [7], which was enhanced version of DEEC proposed to insert another node in the network (super node) with the existing normal and advanced nodes which increased the heterogeneity and lifetime as well. It has been evaluated in that DDEEC has low stability period, lifetime and throughput as compared to the EDEEC. So EDEEC act as motivating factor to work on and improve it further. EEN [8] which was a threshold sensitive reactive protocol proposed scheme to minimize the transmission time as transmission consume more energy than processing of data at the nodes. This was done to impart two threshold parameters, hard and soft threshold. A node only transmit when currently sensed value is greater than hard threshold and difference between current sensed and previous sensed value is greater than soft threshold .This protocol is a kind optimization technique which can optimize the communication in a good manner. In this paper we worked on LEACH, SEP, Z-SEP and TDEEC, and successfully approached to make use of the best of these protocols and our protocol TDEEC successfully improved the stability period and throughput of the network which ultimately enhanced the life of the network.

## II. ROUTING PROTOCOL

A routing protocol specifies how routers communicate with each other, disseminating information that enables them to select routes between any two nodes on a computer network. Routing algorithms determine the specific choice of route. Each router has a priori knowledge only of networks attached to it directly. A routing protocol shares this information first among immediate neighbors, and then throughout the network. This way, routers gain knowledge of the topology of the network. In this section we describe some routing protocols.

### A. Threshold Sensitive Distributed Energy Efficient Clustering (TDEEC)

Our approach is minimize transmission time in the network. The basic theory is that clustering is done because the nodes which are clustered have a sensed data which vary in very insignificant amount. So cluster head in a cluster when take the data from their members is similar in nature. Cluster heads have to send similar type of data again and again to base station which is time consuming and wastage of energy by the cluster heads. This concept was explored in detail in TEEN which imposed two thresholds hard and soft threshold which optimized the communication and prolong the life of the network. We tried to use the optimization Protocol TEEN on enhanced version of DEEC i.e. EDEEC. But we according to our scheme we first increased the stability period by introducing a new node "super advanced" in our network. Introducing a node increased the heterogeneity to level four but thing is that it is not using nodes having energy more than super nodes as in EDEEC. So nodes are in our scheme are

$$\text{normal nodes: } E_0$$
$$\text{advanced nodes: } E_0(1+a)$$
$$\text{super nodes: } E_0(1+b)$$
$$\text{superadvanced nodes: } E_0(1+c)$$

Where $a = \frac{c}{2};\ b = \frac{3c}{4}; c = 1$

Here $p_{opt}$ is probability of choosing the cluster heads in the network so a node become eligible for cluster head again after 1/p0 rounds. So average no of cluster heads should be $n * p_{opt}$ if n is total no of nodes. In our scheme nodes are distributed according to constant m and m0 and nodes are:

$$\text{normal nodes} = (1-m) * n$$
$$\text{advanced nodes} = (1-m0) * m * n$$
$$\text{super nodes} = (m0 * m * n)/2$$
$$\text{superadvanced nodes} = \frac{m0 * m * n}{2}$$

Therefore total energy of the network in a round is

$$E_0 * (1-m) * n + E_0(1+a) * (1-m0) * m * n + E_0(1+b) * \frac{m0*m*n}{2} + E_0(1+c) * \frac{m0*m*n}{2} = n * E_0(1 + a * m - m * m0 * (a - (\frac{b+c}{2})) \quad (1)$$

So, weighed probabilities of different nodes are

$$p_{norm} = \frac{p_{opt}}{\left(1 + a * m - m * m0 * (a - (\frac{b+c}{2})\right)}$$
$$p_{adv} = \frac{p_{opt}(1+a)}{\left(1 + a * m - m * m0 * (a - (\frac{b+c}{2})\right)}$$
$$p_{super} = \frac{p_{opt}(1+b)}{\left(1 + a * m - m * m0 * (a - (\frac{b+c}{2})\right)}$$
$$p_{sadv} = \frac{p_{opt}(1+c)}{\left(1 + a * m - m * m0 * (a - (\frac{b+c}{2})\right)} \quad (2)$$

Ultimately our new threshold for deciding the cluster heads election is as:

$$T(i) = \begin{cases} \frac{p_{norm}}{1 - p_{norm}(r \times \mod(\frac{1}{p_{norm}}))} & \text{if i is normal node and } i \in G \\ \frac{p_{adv}}{1 - p_{adv}(r \times \mod(\frac{1}{p_{adv}}))} & \text{if i is advance node and } i \in G' \\ \frac{p_{super}}{1 - p_{super}(r \times \mod(\frac{1}{p_{super}}))} & \text{if i is super node and } i \in G'' \\ \frac{p_{sadv}}{1 - p_{sadv}(r \times \mod(\frac{1}{p_{sadv}}))} & \text{if i is superadvanced node and } i \in G''' \\ 0 & \text{otherwise} \end{cases} \quad (3)$$

Now, cluster heads are made according to eq.3. We randomly take a number g between [0, 1]. If the threshold T (i) for $i^{th}$ node is greater than g and node i belongs to set (G or G' or G'' or G''') then it become cluster head otherwise it will be a simple node. Here G, G', G'' and G''' are set of normal, advanced, super and super advanced nodes respectively which has not become cluster heads yet. Cluster heads gather the data from its cluster members and they will not send sensed data to Base station as they receive the value. The TEEN is implemented in the nodes. These cluster heads nodes store two threshold hard and soft thresholds. Hard threshold (h) is calculated over highest and lowest value sensed by the nodes. For example in temperature sensing Applications the hard threshold is calculated as the average of maximum temperature sensed and minimum temperature sensed. In our scenario we have simulated our network as temperature sensing wireless sensor network and hard Threshold is taken as 100 (in degree Celsius). Also, we are using the term data for the temperature sensed by the nodes. The sensed value is stored as a variable in the node, called effective sensed value(SV). The nodes will next transmit data only when the following conditions are met:

1. The current value of the sensed data (CV) is greater than the hard threshold.( CV>h) and
2. The current value of the sensed attribute (CV) differs from SV by an amount equal to or greater than the soft threshold (diff=CV-SV).

Whenever a node transmits data, SV become the current value of the sensed attribute. Here, in this scheme we have taken s=2(in degree Celsius). These thresholds are making our scheme to work in reactive way as TEEN as Transmission is not periodically as in LEACH, SEP. The transmission of data is done after receiving the value and applying the thresholds. So data is sent in a non-periodically fashion according to importance of the sensed data. Thus our scheme TDEEC optimized the communication in the networks and makes the communication energy-efficient.

## III. SIMULATION PAPRAMETERS

In order to appraise the performance of our proposed protocol, we simulated our protocol using MATLAB. We consider a wireless sensor network with 100 nodes distributed randomly in 100m X 100m field. A gateway node is deployed at the Centre of the sensing field. The BS is located far away from the sensing field. Both gateway node and BS are stationary after deployment. We consider packet size of 4000 bits.

**Table 1. The Radio Parameters**

| Parameters | Value |
|---|---|
| Initial Energy Eo | 0.5J |
| Initial Energy of advanced nodes | 0,1J |
| Energy for data aggregation | 50 pj/bit/signal |
| Number of nodes | 100 |
| Packet size | 4000bit |
| Transmission and receiver electronics | 50nj/bit |
| Transmitter amplifier | 100 pj/bit/m2 |

Performance metrics used in the simulations are:

1. Number of alive nodes per round.
2. Number of dead nodes per round.
3. Throughput, number of packets sent from cluster heads to base station.

## IV. RESULTS & DISCUSSIONS

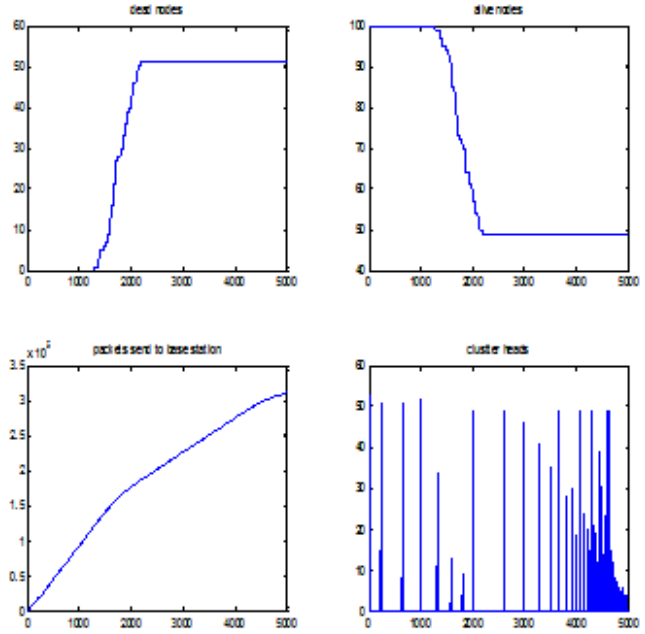


**Fig 1. Network Parameters of TDEEC Protocol.**

**Table 1: Comparison of energy efficient routing protocol at 4000 rounds**

| Protocol | No of Alive Nodes | No of Dead Nodes | No of Packets Sent To Base Station |
|---|---|---|---|
| LEACH | 3 | 92 | 1.892e+04 |
| SEP | 1 | 96 | 2.234e+04 |
| TDEEC | 46 | 57 | 3.456e+05 |

## V. CONCLUSION

In this paper, we presented a more optimized routing scheme for WSNs. Main focus was to enhance cluster-head selection process. In this, our proposed strategy (TDEEC), stability period of network and life time has been optimized. Simulation results show that there is significant improvement in all these parameters when compared with some of the existing routing protocols e.g., SEP, Z-SEP, LEACH and DEEC.

## VI. REFERENCES

[1] W. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "Energy-efficient communication protocol for wireless sensor networks," in the Proceeding of the Hawaii International Conference System Sciences, Hawaii, January 2000.

[2] W.R. Heinzelman, A.P. Chandrakasan, H. Balakrishnan, "An application specific protocol architecture for wireless microsensor networks", IEEE Transactions on Wireless Communications 1 (4) (2002) 660-670.

[3] Lindsey S, Raghavenda CS. PEGASIS : Power efficient gathering in sensor information systems[C].Williamson DA.Proc of the IEEE Aerospace Conf .New York: IEEE Press,2002:1125-1130.

[4] G. Smaragdakis, I. Matta, A. Bestavros, "SEP: A Stable Election Protocol for clustered heterogeneous wireless sensor networks", in: Second International Workshop on Sensor and. Actor Network Protocols and Applications (SANPA 2004), 2004.

[5] Aderohunmu, F.A. and Deng, J.D., "An Enhanced Stable Election Protocol (ESEP) for Clustered Heterogeneous WSN".

[6] S. Faisal, N. Javaid, A. Javaid, M. A. Khan, S. H. Bouk and Z. A. Khan, "Z-SEP: Zonal-Stable Election Protocol for Wireless Sensor Networks" Journal of Basic and Applied Scientific Research (JBASR), 2013.

[7] L. Qing, Q. Zhu, M. Wang, "Design of a distributed energy-efficient clustering algorithm for heterogeneous wireless sensor networks". ELSEVIER, Computer Communications 29, 2006, pp 2230- 2237.

[8] Elbhiri, B. , Saadane, R. , El Fkihi, S. , Aboutajdine, D. "Developed Distributed Energy-Efficient Clustering (DDEEC) for heterogeneous wireless sensor networks", in: 5th International Symposium on I/V Communications and Mobile Network (ISVC), 2010.