IJESMR
International Journal OF Engineering Sciences & Management Research

PERFORMANCE ANALYSIS OF WIRELESS CHANNEL

Dr. Ch.Usha Kumari, Professor[*1] & M. Ramya Krishna, M.Tech Scholar [2]
[*1]Department of E.C.EGokaraju Rangaraju Institute Engineering and Technology Hyderabad, India
[2]Department of E.C.E Gokaraju Rangaraju Institute Engineering and Technology Hyderabad, India

Keywords: Heterogeneous Networks, DEEC, Stability Period and Network Lifetime.

ABSTRACT
In recent years, there has been a noticeable increase in the usage of wireless sensor networks in numerous backgrounds for example military operations and monitoring systems. These networks contain various sensor nodes having narrow power resource, which transmits the sensed data to the Base Station (BS) that requires more energy usage. Saving energy and prolonging the wireless sensor network lifetime, enforces a great challenge.For improved working of network many clustering algorithms have been proposed, mostly focusing on energy efficiency and network lifetime. In this paper, we first check Distributed Energy- Efficient Clustering (DEEC) and Threshold DEEC (TDEEC) beneath some different scenarios covering high levels of heterogeneity to low levels of heterogeneity. We have observed comprehensively regarding the performance built on stability period and network life time. TDEEC performs superior in all heterogeneous situations containing adaptable heterogeneity in terms of network life time, however TDEEC is best of both for the stability period of the network.

INTRODUCTION
In numerous critical applications Wireless Sensor Networks are very advantageous such as military surveillance environmental, temperature, pressure, traffic, disaster areas and vibration monitoring. All the sensor nodes have to transmit their data towards Base Station often known as sink. Usually sensor nodes in WSN are power constrained payable to limited battery, that is also not possible to replace battery of previously deployed sensor nodes and nodes may be distributed where they can't accessed. Nodes may be placed far away from Base Station so direct communication is not possible due to less battery as in direct communication require more energy[1]. Cluster formation is the key method for reducing battery consumption in which nodes of the cluster elects one Cluster Head [2].

WSN is one of the group belongs to ad-hoc networks. These networks consist of sensor nodes. A sensor node is a device which converts a sensed parameter like temperature, pressure, vibrations into a recognized form of users. In this network data is requested depending on certain physical quantity. A sensor node consists of transducer, an embedded processor, a small memory unit and wireless transceiver and all these devices connected to power supplied by a battery [3]. Cluster formation can be done in two ways of networks i.e., homogenous networks and heterogeneous networks. Sensor nodes which have same energy level are known as homogenous network and nodes that have different energy levels are known as heterogeneous network. LEACH (Low-Energy Adaptive Clustering Hierarchy)[4],[5], HEED (Hybrid Energy-Efficient Distributed clustering)[6],[7], PEGASIS (Power Efficient Gathering in Sensor Information Systems)[8] are algorithms for homogeneous networks. Whereas, SEP(Stable Election Protocol)[9], (DEEC)Distributed Energy-Efficient Clustering, DDEEC(Developed DEEC), EDEEC(Enhanced DEEC) and TDEEC(Threshold DEEC) are algorithms for heterogeneous WSN. SEP is for two level heterogeneous network, so it cannot work properly for three or multilevel heterogeneous network. SEP takes only normal nodes and advanced nodes where normal nodes are low energy node and advanced nodes are high energy one. Distributed Energy-Efficient Clustering, D-DEEC, E-DEEC and T-DEEC are considered for multilevel heterogeneous network and they can perform very efficiently in two level heterogeneous networks.

In this paper, we investigate performance of heterogeneous Wireless Sensor Network protocols under multilevel heterogeneous networks. We have compared the performance of DEEC and T-DEEC for different conditions of multilevel heterogeneous WSN. Three level heterogeneous networks contain normal nodes, advanced nodes and super nodes whereas super nodes contain high energy level as compared to normal nodes and advanced nodes[10].

It is found that various protocols have various efficiency for three level and multilevel heterogeneous Wireless Sensor Networks in terms of nodes alive, stability period and network life time. DEEC perform good under three level heterogeneous Wireless Sensor Networks contains high energy level difference among normal nodes,

IJESMR
International Journal OF Engineering Sciences & Management Research

advanced and super nodes in terms of stability. However, its deficiency in performance as compared to T-DEEC in terms of lifetime of the network. Whereas, T-DEEC perform well under three and multilevel heterogeneous networks contains lower energy level difference between normal nodes, advanced nodes and super nodes in terms of both network lifetime and stability period[11].

HETROGENEOUS NETWORK MODEL

In this subdivision, let N number of nodes distributed in a square region of M×M dimension. Heterogeneous networks contain two or multi types of nodes regarding their energy levels and are named as two, three and multilevel heterogeneous networks respectively[12].

Two Level Heterogeneous Networks Model

Two level heterogeneous Wireless Sensor Networks contains two energy level of sensor nodes they are normal and advanced nodes. Where, E_0 is the energy of normal nodes and $E_0(1 + a)$ is the energy of advanced nodes containing ‘a’times the energy of the normal nodes. If N is the total number of sensor nodes then ‘Nq’is the total number of advanced nodes where ‘q’refers to the fraction of the advanced nodes and $N(1 - q)$ is the total number of normal nodes. The total early energy of the sensor network is the sum of energies of normal nodes and advanced nodes.

$$E_{Total} = N(1-q) + Nq(1+a)E_0$$

$$E_{Total} = NE_0(1+aq) \quad ....(1)$$

Three Level Heterogeneous Wireless Sensor Networks Model

Three level heterogeneous networks have three energy levels of sensor nodes i.e., normal nodes, advanced nodes and super nodes. Normal nodes that contain energy ofE_0, advanced nodes of fraction ‘q’have ‘a’times more energy than the normal nodes i.e., $E_0(1 + a)$ whereas, the super nodes of fraction m_0 have a factor of ‘c’times extra energy than the normal nodes so their energy i.e., $E_0(1 + c)$. As N the total number of nodes in the sensor network, then Nqm_0 is number of super nodes and $Nq(1 - m_0)$ is number of advanced nodes. The total early energy of three level heterogeneous network is given by:

$$E_{Total} = N(1-q)E_0 + Nq(1-m_0)(1+a)E_0 + Nm_0E_0(1+c)$$

$$E_{Total} = NE_0(1+q(a+m_0c)) \quad ....(2)$$

The three level heterogeneous networks contain $(a + m_0c)$ times more energy than the homogeneous networks.

Multilevel Heterogeneous Wsns Model

Multilevel heterogeneous Wireless Sensor Network is a network which contains nodes of multi energy levels. The early energy of sensor nodes is placed over a close set $[E_0, E_0(1 + a_{max})]$, where E_0 is the low energy bound and a_{max} is the value of maximum energy. Early, node S_i has initial energy of $E_0(1+a_i)$, which is a_i times more than the low energy bound E_0. The total early energy of multi-level heterogeneous WSNs is given by:

$$E_{Total} = \sum_{i=1}^{N} E_0(1+a_i) = E_0(N + \sum_{i=1}^{N} a_i) \quad ....(3)$$

Cluster Head nodes consumes more amount of energy as compared to remaining nodes so after some rounds have finished, energy of all the sensor nodes becomes dissimilar as compared to each other. Therefore, heterogeneity is presented in homogeneous Wireless Sensor Networks and the networks which contain heterogeneity are most important than homogeneous WSNs.

RADIO DISSIPATION MODEL FOR WSN

The radio energy model for WSN describes l bit message is sent over a distance d as in, energy transmitted is then given by:

$$E_{TX}(l,d) = \begin{cases} lE_{ele} + l\varepsilon_{fs}d^2, d < d_0 \\ lE_{ele} + l\varepsilon_{mp}d^4, d \geq d_0 \end{cases} \quad ....(4)$$

Where, E_{ele} is the energy used per bit to run transmitter or receiver in the circuit. ‘d’is the distance between transmitter and receiver. If this distance is lower than the threshold, free space(fs) model is suggested, else multi path(mp) model is suggested. Now, total energy dissipated in the sensor network during a round is given below

$$E_{Round} = l\left(2NE_{ele} + NE_{DA} + K\varepsilon_{mp}d^4{}_{toBS} + N\varepsilon_{fs}d^2{}_{toCH}\right) \quad ....(5)$$

d_{toBS} = average distance between the Cluster Head & BS

d_{toCH} = average distance between the Cluster Head & cluster member

$$d_{toCH} = \frac{M}{\sqrt{2\pi K}}$$

$$d_{toBS} = 0.765\frac{M}{2}$$

$$K_{opt} = \frac{\sqrt{N}}{\sqrt{2\pi}}\sqrt{\frac{\varepsilon_{fs}}{\varepsilon_{mp}}}\frac{M}{d^2_{toBS}}$$

$$\therefore E_{Round} = l\left[2NE_{elc} + NE_{DA} + \sqrt{\frac{N\varepsilon_{fs}\varepsilon_{mp}}{2\pi}}M + 0.1463M^2 + \frac{N\varepsilon_{fs}M^2}{2\pi K}\right] \text{...................(6)}$$

OVERVIEW OF DISTRIBUTED HETEROGENEOUS NETWORKS

DEEC

DEEC is proposed to deal with sensor nodes of heterogeneous networks. For Cluster Head selection, DEEC uses early and residual energy levels of nodes. Here 'i'denotes the number of rounds to be a Cluster Head for node S_i. $P_{opt}N$ is the optimum number of Cluster Heads in the network during each round. Cluster Head selection in DEEC is based on energy levels of nodes. As in homogenous WSN, the nodes with same amount of energy during each time then choosing i = P_{opt} assumes that $P_{opt}N$ Cluster Heads in each round. In WSNs, sensor nodes with high energy level are most probable to become Cluster Head than nodes with lower energy but the total value of Cluster Heads during each epoch is equal to $P_{opt}N$. P_i is the probability for each sensor node S_i to become Cluster Head so, node with higher energy level has more value of P_i when compared to the P_{opt}. $\overline{E(r)}$ Denotes the average energy of the network during each round r which can be given as:

$$\overline{E(r)} = \frac{1}{N}\sum_{i=1}^{N} E_i(r) \text{ ....(7)}$$

Probability for Cluster Head selection in DEEC is given below:

$$P_i = P_{opt}\left[1 - \frac{\overline{E(r)} - E_i(r)}{\overline{E(r)}}\right]$$

$$P_i = P_{opt}\left[\frac{E_i(r)}{\overline{E(r)}}\right] \text{ ....(8)}$$

In DEEC average total number of Cluster Head during each roundis given as:

$$\sum_{i=1}^{N} P_i = \sum_{i=1}^{N} P_{opt}\frac{E_i(r)}{\overline{E(r)}} = NP_{opt} \text{...............(9)}$$

P_i is the probability of each node to become Cluster Head in a round. Where 'G'is set of nodes that are eligible to become a CH at round r. If a node becomes CH in recent number of rounds then it belongs to G. During each round each sensor node selects a random number between 0 and 1. If number is lesser than the threshold as given in equation 12 as in, it is eligible to become a Cluster Head else not.

$$T(S_i) = \begin{cases} \dfrac{P_i}{1 - P_i(r \bmod \frac{1}{P_i})} & S_i \in G \\ 0 & otherwise \end{cases} \text{ ....(10)}$$

As P_{opt} is the reference value of the average probability pi. In homogenous network, all nodes have same early energy so that they use P_{opt} to be reference energy for probability P_i. However in heterogeneous network, the value of P_{opt} is unlike according to the early energy of the node. In two level heterogeneous networks the value of P_{opt} is given as

$$P_{adv} = \frac{P_{opt}}{1 + aq}$$

$$P_{nrm} = \frac{P_{opt}(1 + a)}{1 + aq}$$

Then use the above given P_{adv} and P_{nrm} instead of P_{opt} in the equation 8 for two level heterogeneous networks as supposed in:

IJESMR
International Journal OF Engineering Sciences & Management Research

$$P_i = \begin{cases} \dfrac{P_{opt}E_i(r)}{(1+aq)\overline{E(r)}} & if\ S_i\ is\ the\ Normal\ node \\ \dfrac{P_{opt}(1+a)E_i(r)}{(1+aq)\overline{E(r)}} & if\ S_i\ is\ the\ advanced\ node \end{cases} \quad ....(11)$$

Above model can be extended to multilevel heterogeneous networks given below as:

$$P(S_i) = \frac{P_{opt}N(1+a_i)}{(N+\sum_{i=1}^{N}a_i)} ....(12)$$

Above $P(S_i)$ in the equation 10 instead of P_{opt} to get P_i for heterogeneous node. P_i for the multilevel heterogeneous networks is given as:

$$P_i = \frac{P_{opt}N(1+a_i)E_i(r)}{\left(N+\sum_{i=1}^{N}a_i\right)\overline{E(r)}} ....(13)$$

In DEEC we estimate average energy E(r) of the network for any round r as in:

$$\overline{E(r)} = \frac{1}{N}E_{Total}\left(1-\frac{r}{R}\right)...............(14)$$

R denotes total number of rounds of network lifetime and is valued as follows:

$$R = \frac{E_{Total}}{E_{Round}} ....(15)$$

E_{total} is the total energy of network where E_{round} is energy spending during each round.

T-DEEC

T-DEEC uses the same mechanism for Cluster Head selection and average energy calculation as proposed in the DEEC. At each epoch, nodes will decide whether to become a Cluster Head or not by selecting a random number from 0 to 1. If the number is lesser than the threshold T_s as given in equation 16 then nodes will decide to become a Cluster Head for the given round. In T-DEEC, threshold value is in sync and based on that value a sensor node decides whether to become a Cluster Head or not by presenting residual energy and the average energy of particular round with respect to the optimum number of Cluster heads. Threshold value in T-DEEC is given as follows:

$$T(S) = \begin{cases} \dfrac{P}{1-P(r \bmod \frac{1}{p})} * \dfrac{\text{Residual energy of anode} * k_{opt}}{\text{Average energy of network}} & \text{if} \quad S \in G \\ 0 & \text{otherwise} \end{cases} \quad ....(16)$$

RESULTS AND DISCUSSION

Case 1

Taking a=1; b=2; m=0.5;mo=0.4;the variation of packets from clusters to the base station in DEEC, DDEEC and TDEEC has been shown in below figure. From this figure we can find that packets sent to base station for DEEC and DDEEC vary linearly from 0 to 2500 rounds from there it remains constant till 10000 rounds that is at 0.75×10^5 for DEEC. But in TDEEC packets sent to base station are increasing linearly from 0 to 5000 rounds then remaining constant at 3.25×10^5.

IJESMR
International Journal OF Engineering Sciences & Management Research

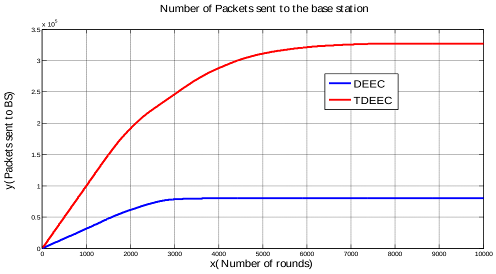

Fig 1:Variation of packets sent to base station in DEEC and T-DEEC for case 1

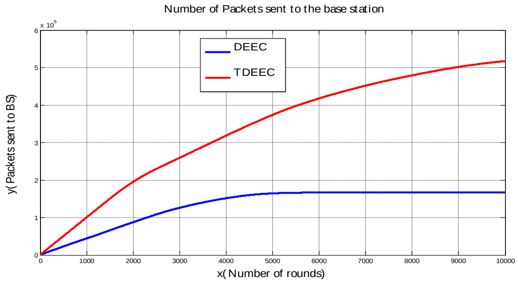

Fig 2: Variation of packets sent to Base Stationfor DEEC and T-DEEC for case 2

In the above figure taking a=2; b=4;m=0.6;mo=0.5;From this figure we can find that packets sent to base station for DEEC vary from 0 to 3500 rounds from there it remains constant till 10000 rounds that is at 1.75x10^5 for DEEC. But in TDEEC packets sent to base station are increasing linearly from 0 to 10000.

CONCLUSION

In this paper we have examined DEEC and T-DEECfor heterogeneous Wireless Sensor Networks containing different levels of heterogeneity. Simulations done in this paper prove that DEEC perform good in the networks containing high energy difference between normal nodes, advanced nodes and super nodes. Whereas, we find out that TDEEC perform well in all cases. TDEEC has best performance in terms of stability period and life time. Hence TDEEC is improved in terms of stability period while compromising on lifetime

REFERENCES

1. I.F. Akyildiz, W. Su, Y. Sankarasubramaniam, E. Cayirci, “Wireless sensor networks: a survey, Computer Networks”, 38 (4) (2002) 393-422.
2. P. Krishna, N.H. Vaidya, M. Chatterjee, D. Pradhan, “A cluster-based approach for routing in dynamic networks, ACM SIGCOMM Computer Communication Review“, 27 (2) (1997) 49-65.
3. B. McDonald, T. Znati, “Design and performance of a distributed dynamic clustering algorithm for Ad-Hoc networks”, in: Proceedings of the Annual Simulation Symposium, 2001.
4. Ch.Usha Kumari and M. Ramya Krishna, “High Performance Wireless Communication Channel using LEACH Protocols”,Pak. J. Biotechnol. Vol. 13 special issue II (International Conference on Engineering and Technology Systems (ICET’16) Pp. 52 - 56 (2016)
5. W.R. Heinzelman, A.P. Chandrakasan, H. Balakrishnan, “Energy efficient communication protocol for wireless micro sensor networks”, in: Proceedings of the 33rd Hawaii International Conference on System Sciences (HICSS-33), January 2000.
6. 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.
7. O. Younis, S. Fahmy, HEED: “A hybrid, energy-efficient, distributed clustering approach for ad hoc sensor networks”, IEEE Transactions on Mobile Computing 3 (4) (2004) 660-669.
8. S. Lindsey, C.S. Raghavenda, PEGASIS: “Power Efficient Gathering in Sensor Information Systems”, in: Proceeding of the IEEE Aerospace Conference, Big Sky, Montana, March 2002.
9. G. Smaragdakis, I. Matta, A. Bestavros, “SEP: A Stable Election Protocol for clustered heterogeneous wireless sensor network”, in: Second International Workshop on Sensor and Actor Network Protocols and Applications (SANPA 2004), 2004.

IJESMR
International Journal OF Engineering Sciences & Management Research

10. L. Qing, Q. Zhu, M. Wang, "Design of a distributed energy-efficient clustering algorithm for heterogeneous wireless sensor network", ELSEVIER, Computer Communications 29, 2006, pp 2230-2237.
11. 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.
12. Parul Saini, Ajay.K.Sharma, "E-DEEC- Enhanced Distributed Energy Efficient Clustering Scheme for heterogeneous WSN", in: 2010 1st International Conference on Parallel, Distributed and Grid Computing (PDGC - 2010)