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PERFORMANCE MEASURE IN WIRELESS SENSOR NETWORKS BASED ON DISTRIBUTED ENERGY EFFICIENT CLUSTERING

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Abstract: The performance of DEEC clustering algorithms on the basis of stability period, network life time and throughput for different level of heterogeneous wireless sensor networks is analysis on the basis of prolonging stability period, network life time of nodes alive during rounds for numerous three level heterogeneous networks. Information from sensor nodes is forwarded to cluster heads (CHs) and these CHs are responsible to transmit this information to base station (BS) which is placed far away from the field.
Index Term s: WSNs, Protocols, Clustering, application.

I. INTRODUCTION

Wireless Sensor Networks (WSNs) are ad-hoc networks, consisting of spatially distributed devices (motes) using sensor nodes to cooperatively monitor physical or environmental conditions at different locations. Devices in a WSN are resource constrained; they have low processing speed, storage capacity, and communication bandwidth. In most settings, the network must operate for long periods of time, but the nodes are battery powered, so the available energy resources limit their overall operation. To minimize energy consumption, most of the device components, including the radio, should be switched off most of the time [1]. Another important characteristic is that sensor nodes have significant processing capability in the ensemble, but not individually. Nodes have to organize themselves, ad-ministering and managing the network all together, and it is much harder than controlling individual devices. Furthermore, Sensor nodes have ability to sense and send sensed data to Base Station (BS). Sensing as well as transmitting data towards BS requires high energy. In WSNs, saving energy and extending network lifetime are great challenges. Clustering is a key technique used to Optimize energy consumption in WSNs.

II. WIRELESS SENSOR NETWORKS (WSNS)

If Wireless Sensor Networks (WSN) have gained world-wide attention in recent years due to the advances made in wireless communication, information technologies and electronics field. The development of low-cost, low-power, a multifunctional sensor has received increasing attention from various industries. Sensor nodes or motes in WSNs are small sized and are capable of sensing, gathering and processing data while communicating with other connected nodes in the network, via radio frequency (RF) channel. Wireless sensor network [3] are one of the category belongs to ad-hoc networks. Sensor network are also composed of nodes[4]. Here actually the node has a specific name that is “Sensor” because these nodes are equipped with smart sensors. A sensor node is a device that converts a sensed characteristic like temperature, vibrations, pressure into a form recognize by the users. Wireless sensor networks nodes are less mobile than adhoc networks. So mobility in case of ad-hoc is more. In wireless sensor network data are requested depending upon certain physical quantity. So wireless sensor network is data centric[7]. A sensor consists of a transducer, an embedded processor, small memory unit and a wireless transceiver and all these devices run on the power supplied by an attached battery.

III. ROUTING PROTOCOL

Routing in WSNs is a hard challenge due to the inherent characteristics that distinguish these networks from other wireless networks like mobile ad hoc networks or cellular networks[5]. Routing protocols in WSNs might differ depending on the application (Protocol-Operation-based) and network architecture (Network-Structure-based) as shown in Fig.1.

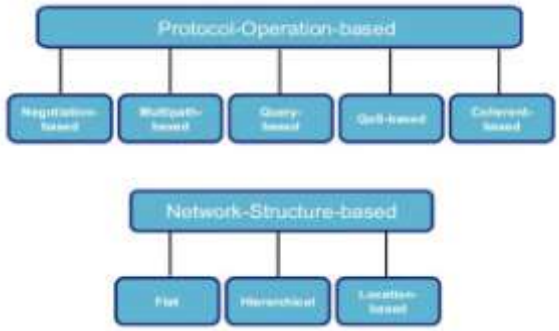

Fig.1 Classification of WSN Routing Protocols

IV. CLUSTERING

DEEC is designed to deal with nodes of heterogeneous WSNs. For CH selection, DEEC uses initial and residual energy level of nodes. Let ni denote the number of rounds to be a CH for node si. Popt N is the optimum number of CHs in our network during each round[6]. CH selection criteria in DEEC are based on energy level of nodes. As in homogenous network, when nodes have same amount of energy during each epoch then choosing pi = popt assures that poptN CHs during each round. In WSNs, nodes with high energy are more probable to become CH than nodes with low energy but the net value of CHs during eachround is equal to poptN. pi is the probability for each node si to become CH, so, node with high energy has larger value of pi as compared to the popt. E(r) denotes average energy of network during round r which can be given as in [2].

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

Probability for CH selection in DEEC is given as

$$p_i = p_{opt}[1 - \frac{\bar{E}(r) - E_i(r)}{\bar{E}(r)}] = p_{opt}\frac{E_i(r)}{\bar{E}(r)}$$

In DEEC the average total number of CH during each round is given as

$$\sum_{i=1}^{N} p_i = \sum_{i=1}^{N} p_{opt}\frac{E_i(r)}{\bar{E}(r)} = p_{opt}\sum_{i=1}^{N}\frac{E_i(r)}{\bar{E}(r)} = Np_{opt}$$

pi is probability of each node to become CH in a round. Where G is the set of node eligible to become CH at round r. If node becomes CH in recent rounds then it belongs to G. During each round each node chooses a random number between 0 and 1. If number is less than threshold as defined below, it is eligible to become a CH else not.

$$T(s_i) = \begin{cases} \frac{p_i}{1-p_i(r \bmod \frac{1}{p_i})} & if\ s_i \epsilon G \\ 0 & otherwise \end{cases}$$

As popt is reference value of average probability pi. In homogenous networks, all nodes have same initial energy so they use popt to be the reference energy for probability pi. However in heterogeneous networks, the value of popt is different according to the initial energy of the node. In two level heterogenous network the value of popt is given by

$$p_{adv} = \frac{p_{opt}}{1+am}, p_{nrm} = \frac{p_{opt}(1+a)}{(1+am)}$$

Then use the above padv and pnrm instead of popt in equation (5.6) for two level heterogeneous network as

$$p_i = \begin{cases} \frac{p_{opt}E_i(r)}{(1+am)\bar{E}(r)} & if\ s_i\ is\ the\ normal\ node \\ \frac{p_{opt}(1+a)E_i(r)}{(1+am)\bar{E}(r)} & if\ s_i\ is\ the\ advanced\ node \end{cases}$$

Above model can also be extended to multi-level heterogenous network given below as Above p multi in equation instead of popt to get pi for heterogeneous node. pi for the multilevel heterogeneous network is given by

$$p_i = \frac{p_{opt}N(1+a)E_i(r)}{(N+\sum_{i=1}^{N} a_i)\bar{E}(r)}$$

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

$$E(r) = \frac{1}{N}E_{total}(1 - \frac{r}{R})$$

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

$$R = \frac{E_{total}}{E_{round}}$$

Etotal is total energy of the network where Eround is energy expenditure during each round.

V. IMPLEMENTATION RESULT

Distributed Energy Efficient Clustering (DEEC) in wireless sensor network is present. Simulation is presented using Matlab. We simulate different clustering protocols in heterogeneous WSN using MATLAB and for simulations we use different nodes randomly placed in a field of dimension 50m×50m. For simplicity, we consider all nodes are either fixed or micro-mobile and ignore energy loss due to signal collision and interference between signals of different nodes that are due to dynamic random channel conditions. Performance parameters used for evaluation of clustering protocols for heterogeneous WSNs are lifetime of heterogeneous WSNs, number of nodes alive during rounds and data packets sent to BS.

1. Lifetime is a parameter which shows that node of each type has not yet consumed all of its energy.
2. Number of nodes alive is a parameter that describes number of alive nodes during each round.
3. Data packets sent to the BS is the measure that how many packets are received by BS for each round.

These parameters depict stability period, instability period, energy consumption, data sent to the BS, and data received by BS and lifetime of WSNs. Stability period is period from start of network until the death of first node whereas, instability period is period from the death of first node until last one. Distributed Energy Efficient Clustering (DEEC)[2] in heterogeneous wireless sensor network with 6000 number of rounds and 200 nodes: Following Design parameters are chosen to perform the analysis of the Distributed Energy Efficient Clustering (DEEC) in heterogeneous wireless sensor network. Parameters Values: Network field (Size) 50m * 50m, Initial Energy of normal node (Eo) 0.8 J, Popt 0.1 J, Efs 10nJ/bit/m2, Number of nodes 200, message size 6000 bit ,EDA 5nJ/bit/ signal, Eelec 50 nJ/bit, Transmit amplifier (Eamp) 0.0013 pJ/bit/m4, Threshold distance (do) 70m.

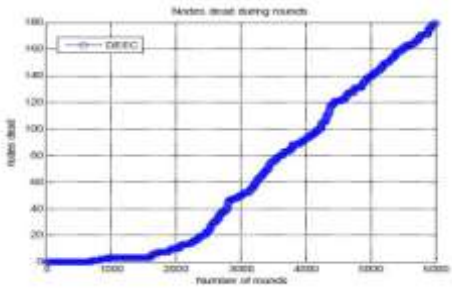

Fig. 2 Dead Nodes during 6000 rounds and 200 nodes

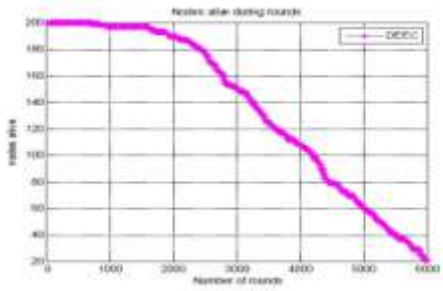

Fig. 3 Alive Nodes during 6000 rounds and 200 nodes

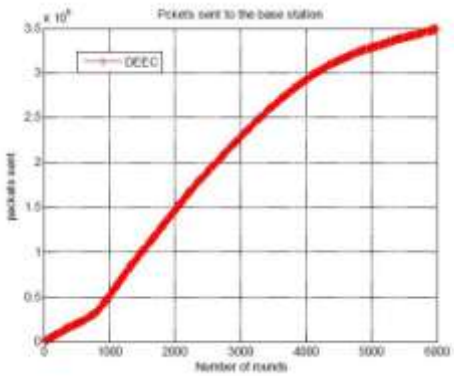

Fig. 4 Packet sends to BS Nodes during 6000 rounds and 200 nodes

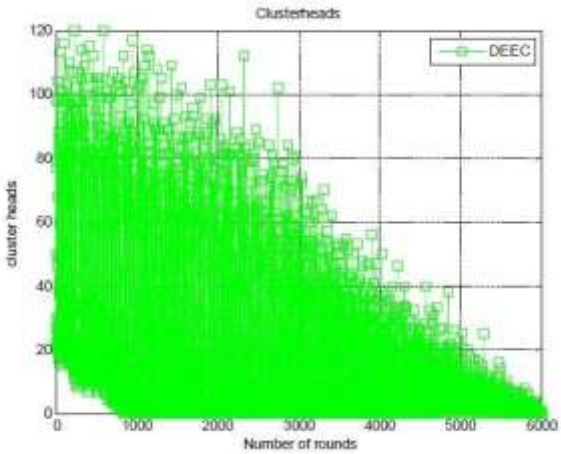

Fig. 5 Count of Cluster Head per round during 6000 rounds and 200 nodes

VI. CONCLUSION

We evaluate the performance of Distributed Energy Efficient Clustering algorithms on the basis of stability period, network life time and throughput for heterogeneous WSNs. And DEEC perform well under three level heterogeneous WSNs containing high energy level difference between normal, advanced and super nodes in terms of stability period. We focus on the performance of Distributed Energy Efficient Clustering algorithms on the basis of stability period, network life time and throughput for WSNs. Few suggestions for the future work, Distributed Energy Efficient Clustering routing protocol. We can perform the same experiment with other variant of Distributed Energy Efficient Clustering such as Developed DEEC (DDEEC), Enhanced DEEC (EDEEC) and Threshold DEEC (TDEEC).

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