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Centralized Energy Efficient Clustering for Wireless Sensor Networks

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ABSTRACT

WSN is Wireless Sensor Networks ,Formed by hundreds or thousands of motes that communicate with each other and pass data along from one to another. Wireless sensor networks have been widely used in wide variety of applications because of their low cost, low power, small in size, self-organizing behavior in harsh environments. Research done in WSN focus mostly on energy aware computing and distributed computing. Energy usage is vital issue in the design of WSNs. Routing is a vital technology in WSN. Energy efficient routing protocol for Wireless Sensor Networks is one of the most challenging task for researcher. There are many routing protocols like: location based, multipath, data centric, mobility based, hierarchical routing, hybrid routing etc. Hierarchical routing protocols have been proved more energy efficient routing protocols, as compare to flat and location based routing protocols. Centralized Energy Efficient Clustering(CEEC) is routing protocol. Clustering is used to prolong the lifetime of the wireless sensor networks. Clustering is the process where sensing area is divided in groups to balance the energy level of sensor nodes called as clusters. Heterogeneity of nodes with respect to their energy level, has also added extra lifespan for sensor network. An Optimal Clustering technique can reduce the energy consumption in WSN and increase the lifetime of the network. Energy is the main consideration when we analyze routing protocols for WSN. In Centralized Energy Efficient Clustering CEEC, Base Station (BS) centrally selects optimum number of cluster-heads. CEEC enhances the stability and network lifetime.

Keywords/ Index Term— Wireless Sensor Networks, Energy Efficient clustering, Network Lifetime, Energy Reduction

I. INTRODUCTION

Energy usage is an important issue in the design of WSNs which typically depends on portable energy sources like batteries for power. WSNs have discovered a wide range of applications in the recent era. A wireless sensor network (WSN) is typically composed of a large number of low-cost sensor nodes (motes), which work collectively to carry out some real-time sensing and monitoring tasks within a specific area. Energy efficiency and reliability is one of the most important factors in WSNs. Energy efficient routing protocol for Wireless Sensor Networks (WSNs) is one of the most challenging task for researcher. A routing technique plays a key role in their energy consumption. Heterogeneity of nodes with respect to their energy level, has also added extra lifespan for sensor network. In this paper, we propose a Centralized Energy Efficient Clustering (CEEC) routing protocol. In this hierarchical (clustering) techniques can aid in reducing useful energy consumption. routing protocols are discussed based on three categories: Flat based routing, Hierarchical-based routing and Location-based routing on the basis of network structure. Hierarchical routing protocols have been proved more energy efficient routing protocols, as compare to flat and location based routing protocols. They have the common aim of trying to extend the lifetime of the sensor network.

II. LITERATURE REVIEW

M. Aslam [1] In this paper, Energy efficient routing protocol for Wireless Sensor Networks (WSNs) is one of the most challenging task for researcher. Hierarchical routing protocols have been proved more energy efficient routing protocols, as compare to flat and location based routing protocols. Heterogeneity of nodes with respect to their energy level, has also added extra lifespan for sensor network. We propose a Centralized Energy Efficient Clustering (CEEC) routing protocol. We studied that the CEEC has maximum throughput and network lifetime.

M. Aslam [2] In this paper, An energy efficient routing protocol is the major attentiveness for researcher in field of Wireless Sensor Networks (WSNs). In this paper, we present

some energy efficient hierarchal routing protocols, prosper from conventional Low
Energy Adaptive Clustering Hierarchy (LEACH) routing protocol. Fundamental objective of our consideration is to analyze, how these ex- tended routing protocols work in order to optimize lifetime of network nodes and how quality of routing protocols is improved for WSNs. Furthermore, this paper also emphasizes on some issues experienced by LEACH and also explains how these issues are tackled by other enhanced routing protocols from classi- cal LEACH. We analytically compare the features and performance issues of each hierarchal routing protocol. We also simulate selected clustering routing protocols for our study in order to elaborate the enhancement achieved by ameliorate routing protocols.

N. Javaid [3] In this paper, heterogenaty –aware multihop CEEC I is proposed. Whole area is divided into three regions and cluster head are formed ,communication is done.

Lalita Yadav [4] In this paper, proposes a new improved cluster algorithm of LEACH protocol which is intended to balance the energy consumption of the entire network and extend the lifetime of the network .

III. Related Work

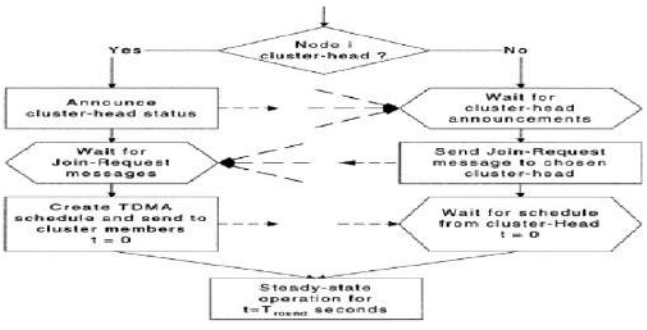
Introduction

WSN is Wireless Sensor Network. WSN consist of number of node that sence the data and communicate with each other with the help base station.

Cluster and Cluster Head formation

Here Clustering is main technique,consist of group of nodes . Cluster having node with maximum energy becomes clusterhead. The set of CHs in a WSN forms its backbone, providing a scalable solution to various networking tasks, such as data collection and habitat monitoring. At each cluster, a CH is responsible for various tasks, e.g. node association,data transmission.

Cluster and Cluster Head formation by LEACH:



Cluster Formation of LEACH Protocol

The LEACH Network is made up of nodes, some of which
are called cluster-heads .The job of the cluster-head is to collect data from their surrounding nodes and pass it on to the base station. LEACH is dynamic because the job of cluster-head rotates. Cluster-heads can be chosen stochastically (randomly based) on this algorithm:

$$T(n) = \frac{P}{1 - P \times (r \bmod P^{-1})} \quad \forall n \in G$$

$$T(n) = 0 \quad \forall n \notin G$$

Where n is a random number between 0 and 1
P is the cluster-head probability and
G is the set of nodes that weren't cluster-heads the previous rounds

If node having highest , then that node becomes a cluster-head . The algorithm is designed so that each node becomes a cluster-head at least once.

Cluster Head selection Algorithm:

Pi(t) is the probability with which node I elects itself to be Cluster Head at the beginning of the round r+1 (which starts at time t) such that expected number of cluster-head nodes for this round is k. eq.1-

$$E[\#CH] = \sum_{i=1}^{N} P_i(t) * 1 = k.$$

k = number of clusters during each round.
N = number of nodes in the network.
Each node will be Cluster Head once in N/k rounds (Round #1,2,3 … Round #N/K, then Round #1, #2, …). – N/K also means cluster size . In each cluster, each sensor has equal chance to become CH. Probability for each node I to be a cluster-head at time eq.2-

$$P_i(t) = \begin{cases} \frac{k}{N - k*(r \bmod \frac{N}{k})} & : \quad C_i(t) = 1 \\ 0 & : \quad C_i(t) = 0 \end{cases}$$

(1)

$C_i(t)$ = it determines whether node I has been a Cluster Head in current round cycle (Total: r rounds; every N/K rounds we form a "cycle"; In each cycle each node should become CH ONLY ONCE). eq.3-

$$E\left[\sum_{i=1}^{N} C_i(t)\right] = N - k * \left(r \bmod \frac{N}{k}\right)$$

eq.4-

$\sum_{i=1}^{N} C_i(t)$ total no. of nodes eligible to be a clusterhead
at time t This ensures energy at each node to be 2pprox.. equal after every N/k rounds. Using (2) and (3), expected no of Cluster Heads per round is, eq.5-

$$E[\#CH] = \sum_{i=1}^{N} P_i(t) * 1$$
$$= \left(N - k * \left(r \bmod \frac{N}{k}\right)\right) * \frac{k}{N - k * \left(r \bmod \frac{N}{k}\right)}$$
$$= k. \quad (5)$$

Cluster Formation Algorithm :

1. Cluster Heads broadcasts an advertisement message (ADV) using CSMA MAC protocol.
   ADV = node's ID + distinguishable header.
2. Based on the received signal strength of ADV message, each non-Cluster Head node determines its Cluster Head for this round (random selection with obstacle).
3. Each non-Cluster Head transmits a join-request message (Join-REQ) back to its chosen Cluster Head using a CSMA MAC protocol.
   Join-REQ = node's ID + cluster-head ID + header.
4. Cluster Head node sets up a TDMA schedule for data transmission coordination within the cluster.
5. TDMA Schedule prevents collision among data messages and energy conservation in non cluster-head nodes.

Cluster and Cluster Head formation by improved LEACH:

This paper considered node energy and position information to improve the LEACH algorithm. It proposed energy balanced clustering algorithm named 2Head-LEACH algorithm to improve the energy of the node.

Clusters-Head Selection

There are many improved methods of the cluster-head selection based on residual energy, the threshold equation in [2] is:

$T(n)=E_{cw}/E_{0*}[p/(1-p*r*mod1/p)]$

Ecur is the current energy of node. E_0 is the initial energy of node. This improvement takes the current energy into consideration, and increases the probability of the high-energy nodes to become cluster-head, but there is also a significant problem. When the remaining energy of a node is very less than threshold value , $T(n)$ becomes very small. The probability of the node random number being smaller than the threshold becomes small, the cluster-head nodes in the network will be too little. The selected cluster-head consumes too much energy and thus affects the network life because of the untimely death. The above method doesn't consider the influence of the distance between nodes and the base station in electing cluster-head. In this paper we are selecting two cluster-head by comparing their energy instead of threshold value. In normal leach protocol, there is only single cluster-head and it depends upon threshold value after sending a data node ,losses some energy so it again apply algorithm to find new cluster head. It causes transmission delay. In proposed technique there are two cluster-head if one goes down second take its position. By doing this 2Head- LEACH algorithm save much energy and reduces transmission delay. Example: - Whenever node transmit a data to the anther node it losses some energy. If we have a WSN with the 100 nodes we divide that 100 node into the number of clusters say four. i.e; each cluster contains 25 nodes. Now we compare the energy of nodes with another node in the same cluster. So we get max energy node. We consider it as cluster-head-1 and apply same logic to find the second cluster head-2. Continue doing this for all the remaining clusters.

IV. COMPARISON RESULTS

Simulation parameters for WSN.

Network size	600*600
Number of nodes	17
Routing Protocol	AODV
Data Packet Size	5000
Initial Energy	100

This section deals with comparing energy efficient data transfer over WSN by improve LEACH protocol and by existing methods. We compared this protocol on following parameters: Energy ;Delay; Jitter

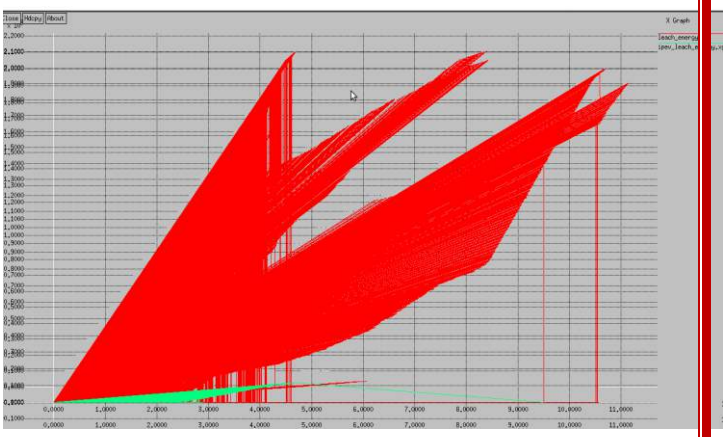


Figure: Energy graph

The above Figure clearly shows that green portion is the energy consumed by improved leach protocol whereas red portion is energy consumed by leach protocol. The energy consumed during transmission of data using leach protocol is more than that consumed by improved leach protocol.

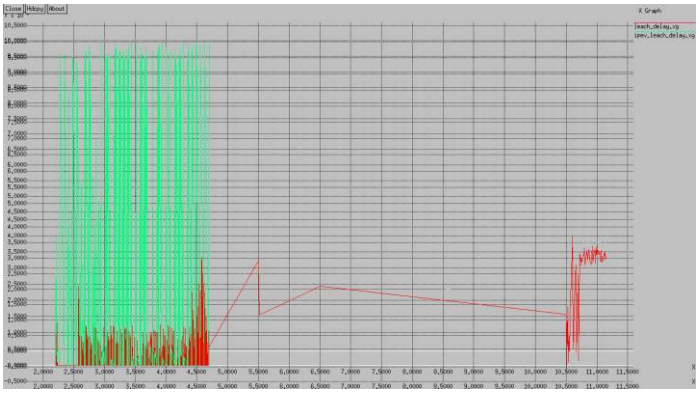


Figure: Delay graph

The above Figure clearly shows that green portion is the delay consumed by improved leach protocol whereas red portion is delay consumed by leach protocol. The delay consumed during transmission of data using leach protocol is more than that consumed by improved leach protocol.

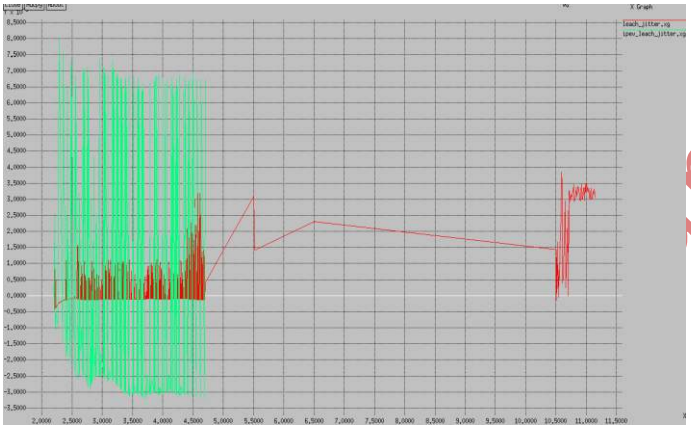


Figure: Jitter graph

The above Figure clearly shows that green portion is the jitter required by improved leach protocol whereas red portion is jitter required by leach protocol. The jitter required during transmission of data using leach protocol is more than that consumed by improved leach protocol.

V. CONCLUSION and FUTURE SCOPE

In this paper, we studied the different Research papers . Routing in sensor networks is a new research area, with a limited but rapidly growing set of results. In last few years, energy conservation in wireless sensor networks has become one of the most important research areas. The main objective behind the routing protocol design is to keep sensors alive as much as possible, thus prolonging the lifetime of network. For heterogeneous wireless sensor networks, many energy efficient clustering protocols are proposed which are based on residual energy, density etc. we proposed a cluster-based multipath delivery scheme for WSNs, which integrates the advantages between hierarchical routing and multipath routing. Hierarchical routing maintains the energy consumption of sensor nodes and performs data aggregation which helps in decreasing the number of transmitted messages to base station. Single-path routing approach is unable to provide efficient high data rate transmission in wireless sensor networks due to the limited capacity of a multi-hop path and the high dynamics of wireless links. this paper, we have presented the application of Clustering. The AODV protocols have been implemented in NS-2 and are analyzed on the basis of five crucial parameters: Throughput, delay, jitter , PDR and energy consumption. After applying the clustering, parameters are improved. This algorithm comprehensively considers the residual energy and distance factors, improves cluster-head election and the strategy of non-cluster head node selecting the optimal cluster-head. As it is proved in the simulation result, the improved algorithm can effectively balance the network energy consumption, heighten system data transmission, and prolong the nodes and network life. In future, researcher can improve energy efficiency by using better data transmission schemes for low delay low energy consumption etc. in critical conditions.

V. REFERENCES

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