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Review for Leach Protocol in WSN

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Abstract **- we study leach protocol of wireless sensor network in this paper. WSN is very vast and interesting field for researcher. Transmission of each packet exists between one sensor nodes to another node by using some routing protocol. One of these routing protocols is LEACH Protocol. This protocol is known as cluster – based protocol. All nodes are separated by clusters. A cluster can have at least two or more than two node. From these nodes one node work as a cluster head (CH) node. All remaining nodes in the cluster send and receive packets through cluster head (CH). These nodes cannot directly communicate with the nodes of other cluster. In this paper we are going to discuss some techniques that are used on leach protocol. Each technique has some results on different parameters. Our main objective is to compare results of techniques that exist. Finally after comparison we find conclusion on the comparative results.**

Keyword **- Wireless sensor network, Leach Protocol, Cluster Head, optimization, GA**

I. INTRODUCTION

Physical and environmental conditions like pressure and temperature etc. autonomous sensors are used to monitor in wireless sensor network (WSN). Data transfer through network to main location. There exist also bi – directional networks now days are used that enable to control on sensor activity. Motivation of this type network due to military but now it use in many other areas like industrial and consumer applications. Basic components are required to build a network. Radio transceiver, GPS, sensors etc. are that basic components that are required to generate the networks as showing in fig 1.

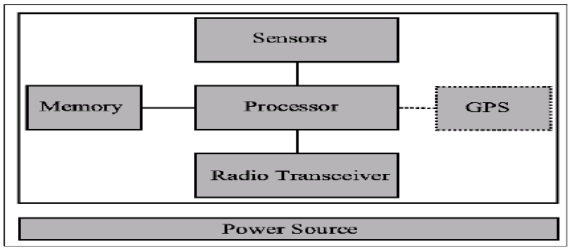

Fig 1 Basic components for WSN

There are many protocols are available in market that are used to provide communication between two sensor nodes in WSN. LEACH is that protocol which explained in this paper.

LEACH is most commonly used protocol in WSN [1]. Cluster mechanism is basic idea for development of LEACH protocol.

In which a cluster is generated with group of two or more than nodes. Size of cluster depends on nodes available in network. Both the process of data processing such as data fusion and aggregation are local to the cluster. A distributed algorithm is used to form clusters and nodes are self-dependent to take decision. There is no centralized control on nodes for grouping. On the basis of probability p CH chosen and this decision distributed to all remaining nodes in a cluster. Than all non-CH nodes choose their cluster so that their least energy consumes to communicate with CH. Total load balanced by changing CH node time to time. Due to this not a particular node gets overloaded and consumed full energy. If number less than threshold value than a node can become a CH for current rotation as showing in equation.

$$T(n) = \frac{p}{1 - p * \left(rmod \frac{1}{p} \right)} \quad : \text{if } n \in G$$

$$T(n) = 0 \quad : \text{Otherwise}$$

Where p is the desired percentage of CH nodes in the sensor population, current round number is represented by r, and the set of nodes is represented by G that have not been CHs in the last 1/p rounds [2]. Leach basic architecture showing in fig 2 as following.

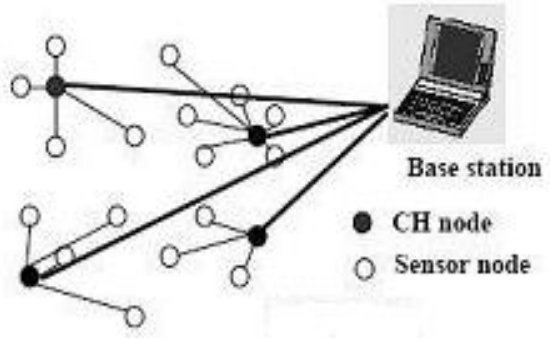

Fig 2 Basic architecture of LEACH

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II. Limitation In Leach Protocol

When CH is selected in randomly way then there is no record account for energy consumption. So a node with low energy has same probability as node of high energy.

If a node with low energy is chosen as CH then this node will die soon due to which WSN cannot exist for a long time. So chosen of CH randomly is main problem of LEACH protocol.

III. Optimization Using Leach Protocol

First of all we have to find the optimum number of clusters *kopt* that surely available. If value of cluster number is less than *kopt*, then non- CH node may consume their energy in the process of transmitting data for the long distance from it to the cluster head, or the responsibility of CH to transmit that data to other nodes. LEACH sets *kopt* as 5% of nodes, but there is no theoretic base exists.

Secondly, each node has hardly equal probability to be a cluster head. It means a node can be CH with energy 2 that have same probability as other node with energy 8. But if a node with low energy is selected than it will soon die due to overload of communication. So this process proceeds against the long network life. It is not good for network robustness.

Due to the long distance between base station and the cluster head, the cluster heads use the multi-path (*d*4 power loss) model, the energy is defined during a single frame that is consumed by cluster node head:

$$E_{CH} = lE_{elec}N_1 + lE_{DA}(N_1 + 1) + lE_{elec} + l_{mp}d_{toBS}^4$$

Where the number of bits is represent by *l* in each data message. Cluster member number *N*1 is the lavatory variable of Poisson distribution, *EDA* represents energy cost of data aggregation; *dtoBS* is the distance from the cluster head to the base station. The average member number of each cluster is [5]:

$$E[N_1|N = n] \approx E[N_1] = \lambda_0/\lambda_1$$

The optimum number of clusters *kopt* is:

$$k_{opt} = \sqrt{\frac{na^2\varepsilon_{fs}}{0.342a^4\varepsilon_{mp} - E_{elec}}}$$

$$p_{opt} = \frac{k_{opt}}{n} = \sqrt{\frac{a^2\varepsilon_{fs}}{n(0.342a^4\varepsilon_{mp} - E_{elec})}}$$

IV. Genetic Algorithm For Leach Protocol

At the starting of preparation phase, it should be determined for each node that whether it is a candidate cluster head (CCH), by following this given procedure of selection. First of all, a random number r is selected by every sensor node from the interval [0, 1]. If *r* is smaller than T(s), based on a prescribed probability *pset*, then the node is a CCH. pset value can be large in protocol, may be = 0.5. Thereafter, each node sends its ID, location information, and whether or not it is a CCH to the BS. A message is received by BS that is sent by all nodes, it performs GA operations to determine the optimal probability, *popt= kopt/n*, by minimizing the total amount of energy consumption in each round. Therefore, the objective function used in the GA can be formulated as

$$f(\vec{x}) = \sum_{c=1}^{k}\sum_{i=1}^{q}(E_{elec} + \varepsilon d^{\alpha}[i, CCH(c)]) \times x_c + \sum_{c=1}^{k}(E_{elec} + E_{DA} + E_{elec} + \varepsilon d^{\alpha}[CCH(c), BS]) \times x_c$$

Where $x = [x1, x2, \ldots, xc, \ldots, xk]$. r The values of *xc* are one for our binary-GA when it is a CCH, otherwise, it is zero. The parameters $\varepsilon=\varepsilon fs$ and $\alpha=2$ were used for $d \le d0$; while, $\varepsilon=\varepsilon mp$ and $\alpha=4$ were set for $d \ge d0$. The symbol *q* represents the number of member nodes in a CCH.

V. Comparison Of Leach-Ga And Optimally Leach

Figure 3 is the solution distribution of *popt* predicted by using the presented LACH-GA for BS located at different positions. The comparison of the values of *popt* computed by LEACH-GA and corrected formula is agreeable, whereas, the data using Heinzelman *et al.*'s formula shown in [3].

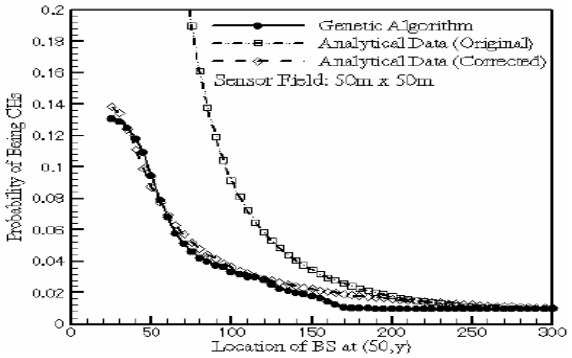

Fig 8 Comparison of optimal probability between analytical analyses and genetic algorithm optimization

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TABLE I lists the simulation results obtained using optimally LEACH and LEACH-Genetic Algorithm protocols for BS located at different positions. 0.6 is taken as initial energy for all nodes and 5 % probability p is used that is same as the setting in [4].

TABLE I.
Comparison Of Network Lifetimes (Number Of Rounds) Between Optimilly Leach And Leach-Ga Protocols

BS (50, y)	Protocol	Prob.	Nodes Dead			
			1%	20%	50%	100%
50	LEACH OPTIMALLY	0.06	1461	1618	1691	1851
	LEACH-GA	0.1307	1610	1732	1818	2040
100	LEACH OPTIMALLY	0.06	1418	1583	1661	1874
	LEACH-GA	0.0946	1512	1663	1717	2078
150	LEACH OPTIMALLY	0.06	1346	1473	1543	1787
	LEACH-GA	0.0334	1356	1482	1554	1815
250	LEACH OPTIMALLY	0.06	951	1027	1098	1298
	LEACH-GA	0.0181	927	1108	1205	1357
300	LEACH OPTIMALLY	0.06	640	776	816	918
	LEACH-GA	0.010	686	874	971	1106

VI. CONCLUSION

This comparison is based only two methods of leach protocol that are genetic algorithm and optimization of leach protocol. We compare both results on the basis of rounds. This comparison is based on optimal thresholding probability for cluster formation. Basically in LEACH probability is determined by user and then a CH is chosen. For this probability, performance of a network is very sensitive and it is very difficult to get an optimum setting from existing prior knowledge. LEACH-GA method outperforms MTE, DT, and LEACH in terms of network lifetime, use for optimal energy-efficient clustering.

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