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A Study and compare of Leach Protocols

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Abstract: A wireless sensor network is a group of specialized transducers with a communications infrastructure for monitoring and recording conditions at diverse locations. Commonly monitored parameters are temperature, humidity, pressure, wind direction and speed, illumination intensity, vibration intensity, sound intensity, power-line voltage, chemical concentrations, pollutant levels and vital body functions. The monitored information's are sent to the central location called sink. The various routing protocols are used to convey the information to the sink individually. Due to this type of communication, all of the nodes need more energy to send the data. So, the lifetime of the network is also reduced. The LEACH protocols were proposed to reduce the drawbacks in existing system. The propose protocols creates a cluster and form a cluster head. All the members' nodes of cluster can communicate with the sink through the cluster head only. In this paper, the different LEACH protocols are going to compare the function and analyze the energy, lifetime, delay and bandwidth of the node.

Keywords: sink, information, protocols, energy

I. INTRODUCTION

[1]A sensor network consists of multiple detection stations called sensor nodes, each of which is small, lightweight and portable. Every sensor node is equipped with a transducer, microcomputer, transceiver and power source. The transducer generates electrical signals based on sensed physical effects and phenomena. The microcomputer processes and stores the sensor output. The transceiver receives commands from a central computer and transmits data to that computer. The power for each sensor node is derived from a battery. Potential applications of sensor networks include:

- Industrial automation
- Automated and smart homes
- Video surveillance
- Traffic monitoring
- Medical device monitoring
- Monitoring of weather conditions
- Air traffic control
- Robot control.

LEACH is a hierarchical protocol in which most nodes transmit to cluster heads, and the cluster heads aggregate and compress the data and forward it to the base station (sink). Each node uses a stochastic algorithm at each round to determine whether it will become a cluster head in this round. LEACH assumes that each node has a radio powerful enough to directly reach the base station or the nearest cluster head, but that using this radio at full power all the time would waste energy.

Nodes that have been cluster heads cannot become cluster heads again for *P* rounds, where *P* is the desired percentage of cluster heads. Thereafter, each node has a 1/*P*probability of becoming a cluster head again. At the end of each round, each node that is not a cluster head selects the closest cluster head and joins that cluster. The cluster head then creates a schedule for each node in its cluster to transmit its data.

All nodes that are not cluster heads only communicate with the cluster head in a TDMA fashion, according to the schedule created by the cluster head. They do so using the minimum energy needed to reach the cluster head, and only need to keep their radios on during their time slot.

II. CLASSIFICATION OF LEACH PROTOCOLS

There are different types of algorithm for different types of leach. The pattern of clustering hierarchy in A-LEACH, C-LEACH and Q-LEACH.

2.1 Assisted-Leach

[5]Assisted Leach protocol has the following sub-stages: • Cluster Head Selection • Cluster Formation • Helper Node Selection • Routing Set-Up • Sensing, Aggregating and Routing Cluster Head Selection The Cluster Head selection follows an extended procedure to Leach's [2] Cluster Head Selection.
Cluster Formation Cluster Heads broadcast a HEAD_BOAST message containing their IDs to facilitate cluster formation. It can happen that a non-cluster node receives such messages from different Cluster Heads. They decide upon the Cluster Head whose message possesses highest Received Signal Strength to be their head and send a JOIN_CLUSTER packet with their IDs to corresponding Cluster Heads showing consent to be part of their clusters.

2.1.1 Helper Node Selection

[5] Helper Node in a Cluster is the node which is nearer to the base station with sufficient remaining energy • Base Station sends a packet containing its ID to every node assuming that the base station can reach every node at single hop over a common channel • The nodes in each cluster store the Base Station ID from the received packet and then make a packet • "RSS_PACKET" with the Received Signal Strength values (RSS Values) and (Self) Node ID as entries A copy of this "RSS_PACKET" is sent to the corresponding Cluster Heads Routing Set-Up • This stage finding the helper node at next hop for each helper node to route aggregated data to base station • In this stage, only the helper nodes are operational and all other nodes including cluster heads go into sleep mode • Each Helper Node sends the "RSS_PACKET" made in Helper Nodes Selection Phase to nodes in transmission range • Thereby, every helper node receives "RSS_PACKET" from all its neighbors.

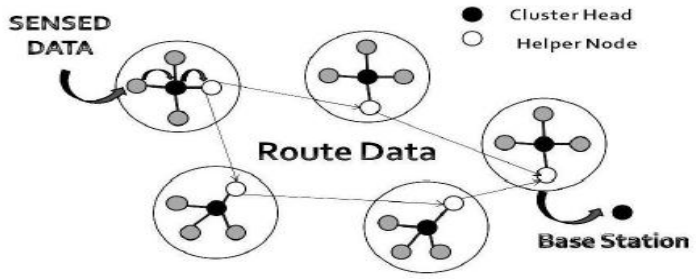

Figure 1: Cluster Architecture

2.2 E-LEACH

[5] A LEACH algorithm inadequacy, this article is designed E-LEACH algorithm to largely solve the above problems, E-LEACH algorithm build cluster after two choices. The first collection of nodes selected to meet the energy conditions and from the minimal condition, The second option is true cluster head selection phase, randomly selected to meet the requirements in the collection of the cluster head node. First, E-LEACH algorithm introduces the concept of the energy threshold. Energy threshold is to determine whether the node can be used as a prerequisite of the cluster head node.

2.3 C-LEACH

[5] LEACH-C (LEACH Centralized)[3] is a kind of improved LEACH. In LEACH-C, the location information and the residual energy value of all the nodes will be sent to the base station at the beginning of each round. After receipting this information, the base station calculates the average energy value of all nodes, the nodes with residual energy higher than average are considered as the candidate, then the base station will select a group of cluster heads from the candidate using the simulated annealing to minimize the objective function. Finally the cluster head group will be broadcasted to the network. If the node's own ID is included in the cluster head group it received, the node will put itself as a cluster head; if not, the node will establish the contact with the corresponding cluster head, and transfer data to the cluster head in the corresponding TDMA slot. LEACH-C will end the process of simulated annealing by controlling the maximum number of iterations until a better solution is got. Since the simulated annealing is a theoretical global optimum algorithm, the result depends on the number of iterations and the choice of the annealing method. The focal point of the simulated

annealing is the introduction of parallel computing to the algorithm [6] or using the algorithm in conjunction with the genetic algorithms [2].

2.4 LEACH-Expected Residual Energy

The LEACH-ERE algorithm [6] practices two descriptors: residual energy and predictable residual energy (ERE) of the sensor nodes for scheming the accidental value with fuzzy logic. The superior casual earnings that the node has more coincidental to be a CH. So as to approximate the ERE, the expected energy consumption (EEC) is mandatory. ERE in apiece round is alteration amongst node residual energy and node EEC. In this process, the amount of groups is secure and strong-minded at the start of networking.

In every clustering round, each sensor node generates a random number between 0 and 1. If the random number for a particular node is bigger than a predefined threshold T , which is the percentage of the desired tentative CHs, the node becomes a CH candidate. Then, the node calculates the chance using the fuzzy inference system which is mentioned above and broadcasts a Candidate-Message with the chance. This message means that the sensor node is a candidate for CH with the value of chance. Once a node advertises a Candidate-Message, the node waits Candidate-Messages from other nodes. If the chance of itself is bigger than every chance values from other nodes, the sensor node broadcasts a CH-Message which means that the sensor node itself is elected as the CH. If a node which is not a CH receives the CH-Message, the node selects the closest cluster head as its CH and sends a JOIN-REQ request to the head.

2.5 LEACH ERE with PSO

Particle swarm optimization (PSO) is a modest, actual and well-organized optimization algorithm. PSO is cast-off to search the search place. It is tranquil to tool and it can be functional for both scientific research and engineering practice. In PSO, a global fitness function is cast-off by all the elements in the swarm. In this, No overlapping and mutation scheming rapidity is very dissolute. It estimates the suitability of every particle. It inhabits the superior optimization capability and it whole effortlessly. Particles in outdated PSO characterize the candidate solutions to a lone optimization problem [4]

The SCH will be a node from selected cluster heads which will be at an optimum distance, system lifetime, least delay, high packet delivery ratio, greater bandwidth and energy deliberation from the base station. Thus by super-clustering we may be cumulative the length of the ultimate conveyed message but by means of only one node for communicating to the base station a ration of energy is protected, since distance factor is abridged. The limitations are designed grounded on the weight basis and D signifies the distance, E represents the energy, P symbolizes the packets and NL means the network lifetime.

$T_c = W_1 * D + W_2 * E + W_3 * P + W_4 * NL$ (1)

Prepare every node weight=0 is
Head=false p
Particles (nodes) =0
Velocity=empty //To supply al neighbor nodes Rendering to instantaneous topology,
Find neighbor //nodes in Range
If distance < Range
Edge exists
Else
No edge exists
Increment weight // connectivity measure
Compute objective function using (1) which performs minimum delay node, maximum packet transmission ratio, minimum energy and high network lifetime nodes
Find high transmission nodes with shortest distance using

$$E_{TX} = E_{elec} \times k + \varepsilon_{amp} \times k \times d^2$$

Set α, β,γ, δ values // control parameters
Iterate i to n times
Select ith node as Super Cluster Head
First-rate neighbor with supreme possibility as subsequent cluster head till all nodes are protected
Evaluate fitness value
The fuzzy rules are produces effective membership functions
The fuzzy parameters act as particle (node)
The fuzzy parameters are optimized using

$$v_{ij} \leftarrow c_o v_i + c_1 r_1(\text{globalbest}_j - x_{ij}) + c_2 r_2(\text{localbestij} - x_{ij}) + c_3 r_3(\text{neighborhoddbest}_j - x_{ij})$$

The procedure is recurrent till aim is attained or optimization technique touched the global best
Update best node as SCH
Discover ultimate set of SCH with supreme possibility (with Weight and Updated nodes)
Get the optimal fuzzy set nodes as SCH
The algorithm describes that the optimal SCH is performed by using PSO based fuzzy approach and also the fuzzy rules are optimized using PSO optimally. It is used to reduce the number of iterations efficiently and improves the network lifetime significantly. A complete novel membership function effectively attuned from normal fuzzy membership function. It could be prepared with exemplification of fuzzy membership function value as particles (nodes). In the every repetition in optimization way, the node characterize will be vagaries to grasp the optimal value. The membership function will shrivels, transfer or enlarge over the vicissitudes of every value. The Fuzzy PSO has attuned fuzzy membership function and enhanced the recital outcome in term precisely to target and quicker in rapidity of convergence.

III. PERFORMANCE EVALUATION

In this trial, the setup deliberated 40 nodes randomly positioned over the area amongst (x=0, y=0) and (x=100, y=100) with BS location (x=50, y=50). We take up four no. of clusters. Every round period is 20s. The bandwidth of the channel is 1 Mbps. Every data message is 500 bytes long; packet header length is 25 bytes. We have cast-off a simple energy prototypical. The communication factors and the essential factors of interest are specified in Table 1.

Parameter	Values
No. of Nodes	100
Network Size	100 X 100 m
Mac	802.11
Radio Range	250m
Simulation Time	2000 sec
Traffic Source	CBR
Packet Size	500 bytes

Performance Metrics

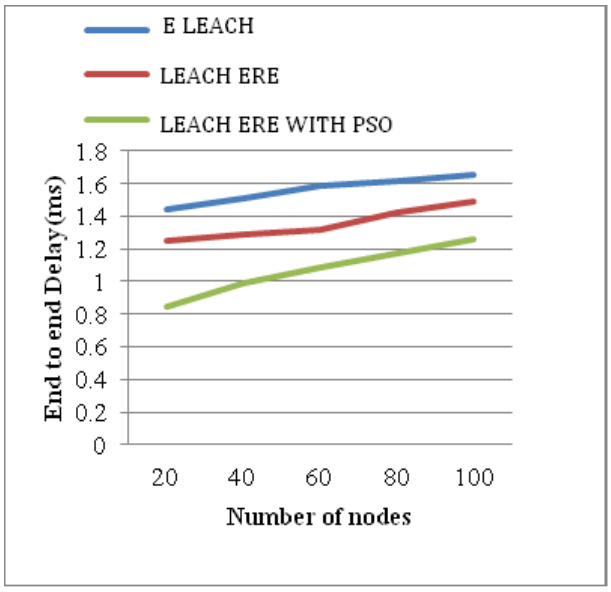

Figure: Number of nodes Vs End to End Delay

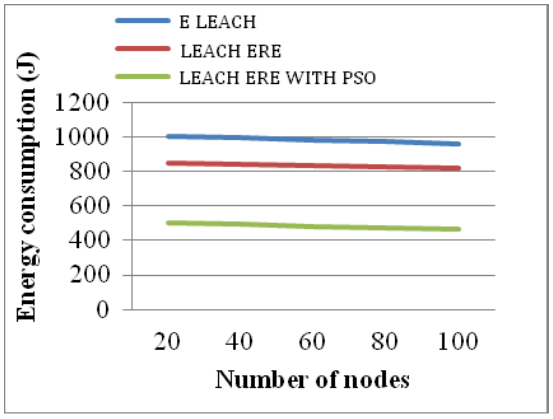

Figure: Number of nodes Vs Energy consumption

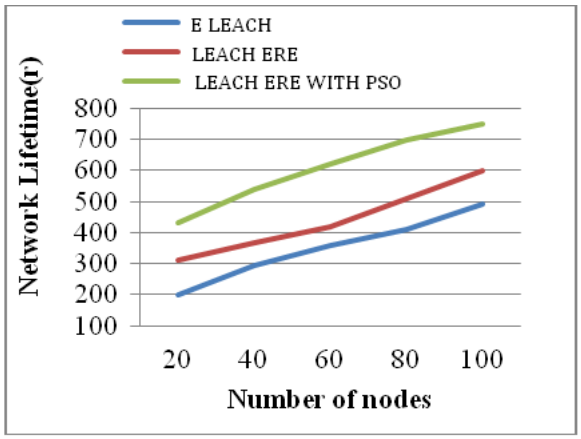

Figure: Number of nodes Vs Network lifetime

IV. CONCLUSION

In this study, various leach protocols are compared with the parameters of lifetime, delay and energy consumption of the nodes. As a result, the LEACH ERE with PSO protocol is better results compared with the others.

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