COMPARISON OF SEP AND LEACH ROUTING PROTOCOL FOR WSN

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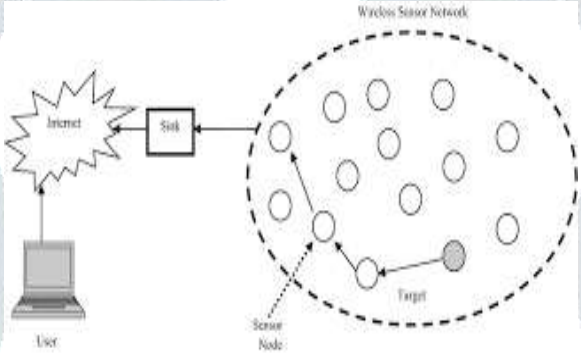
Abstract: Wireless sensor network are introduced to handle complex situations and functions. Energies on nodes are distributed and nodes are hierarchal clustered. In this network some of the nodes become cluster heads, aggregate data and send it to the sink node. LEACH (low energy clustering hierarchy) is used in homogeneous network which is not efficient in terms of energy consumption. SEP (stable election protocol) is used in heterogeneous network where energy on nodes are not distributed uniformly. We propose SEP and LEACH having two level of energies. We show the performance of SEP and leach on the bases of alive nodes, total data received by base station and energy consumption by these protocols after completion of last round in a different network field. This research intends an improvement in network lifetime. Comparative analysis shows the performance of homogeneous and heterogeneous network in different network field.



1.Wireless sensor network

Keywords: Wireless sensor network, LEACH routing protocol, SEP routing protocol.

Introduction

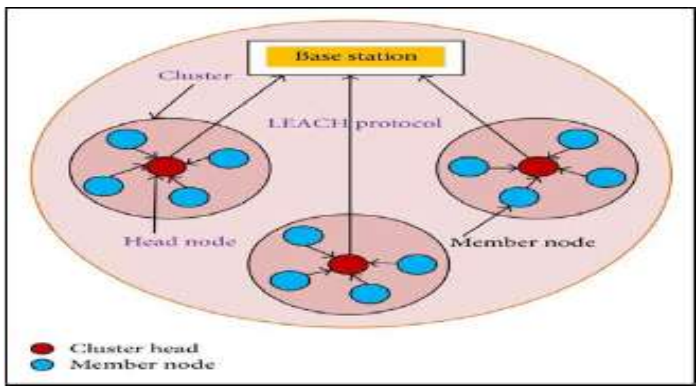
Wireless sensor networks are networks of sensor nodes with very small powered battery & spontaneous formation of network with limited processing power, storage capacity. Nodes aggregate data and send it towards processing station which is known as sink in direct transmission data is directly send to sink. so nodes which are far away from base station dies first and ultimately output is low and in minimum transmission energy, data is send to base station with minimum cost route but transmission power expended so result in more power consumption and former nodes dies first. A solution to these is proposed by LEACH, it rotates cluster heads uniformly among all nodes and data is aggregated by nodes and send it to the base station. Energy distributed in LEACH is homogeneous and if network is of heterogeneous then we use SEP, election probability are weighted by the initial energy of the nodes in that network. SEP minimizes the energy consumption by choosing secondary CHs from existing primary CHs in each round and these secondary CH are elected by the probability, SEP also contain advance nodes which higher energy battery which means nodes with higher energy gives maximum output , lower energy consumption which finally increase the lifetime of the network.

Research Objective

The main objective of the research is to develop new approaches for providing energy efficiency, longer lifetime, quick data delivery for WSNs by evaluating the performance of SEP and LEACH on different parameters those are: Data received by base station, total average energy consumption and alive nodes. To study about the dead nodes occurrence in both the protocols. Evaluation of data received by base station to maximize the throughput. Improve the whole network life cycle, Number of cluster heads per round and Number of alive nodes with respect to energy consumption.

LEACH Routing Protocol

LEACH Protocol is the first protocol of hierarchical routings which proposed data fusion, it is of milestone significance in clustering routing protocols. Many hierarchical routing protocols are improved ones based on LEACH protocol.



2. LEACH Protocol

Leach protocol is a TDMA based MAC protocol. The main aim of this protocol is to improve the lifespan of wireless sensor networks by lowering the energy.
It has two phases:

- Set-up phase
- Steady phase

Operation of leach protocol consists of several rounds with two phases in each round. Leach protocol is a typically representation of hierarchical routing protocol. It is self-adaptive and self-organized. Leach protocol uses round as unit, each round is made up of cluster set-up stage and steady state storage for the purpose of reducing unnecessary energy costs.

A. Set-up phase

In the set-up phase, the main goal is to make cluster and select the cluster head for each of the cluster by choosing the sensor node with maximum energy. Set-up phase has three fundamental steps:

- Cluster head advertisement
- Cluster set up
- Creation of transmission schedule

During the first step cluster head sends the advertisement packet to inform the cluster nodes that they have become a cluster head on the basis of the following formula:

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

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

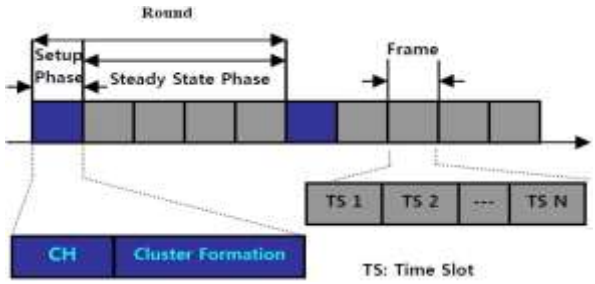
Where n is a random number between 0 and 1
P is the cluster-head probability and
G is the set of nodes that weren't cluster-heads the previous rounds

3. Cluster head selection

T (n) is the threshold. Node becomes cluster head for the current round if the number is less than threshold T (n). Once node is elected as a cluster head then it cannot become cluster head again until all the nodes of the cluster have become cluster head. This is useful for balancing the energy consumption. In the second step, non-cluster head nodes receive the cluster head advertisement and then send join request to the cluster head informing that they are members of the cluster under that cluster head. All non-cluster head nodes save a lot of energy by turning off their transmitter all the time and turn it on only when they have something to transmit to the cluster head In third step, each of the chosen cluster head creates a transmission schedule for the member nodes of their cluster. TDMA schedule is created according to the number of nodes in the cluster. Each node then transmits its data in the allocated time schedule.

B. Steady Phase

In steady phase, cluster nodes send their data to the cluster head. The member sensors in each cluster can communicate only with the cluster head via a single hop transmission Cluster head aggregates all the collected data and forwards data to the base station either directly or via other cluster head along with the static route defined in the source code. After predefined time, the network again goes back to the set-up phase.



4. LEACH protocol process

Advantages of LEACH:

- The strategy of LEACH protocol is completely distributed, it minimizes energy consumption 4 to 8 times lower in case of multi-hop data packets transmission.
- All the sensor nodes in the network die at about the same time due to even distribution of CH work in LEACH protocol.
- The control information from base station is not required for sensor nodes in LEACH protocol.
- LEACH minimizes 7 to 8 times low overall energy consumption as compared to direct transmission and minimum transmission energy (MTE) routing protocol.
- Sensor nodes do not require knowledge of global network or identification in completely distributed wireless sensor network.

Limitation of LEACH:

- Nodes have different energy level, but CH is selected Unreasonably.
- The performance of LEACH protocol is not ideal for large geographical areas.

Methodology

In LEACH every sensor node is initialized to same energy level but in SEP there are two types of nodes:
1) Normal nodes.
2) Advance nodes.
These nodes have different initial energy. There are m advance nodes in a network with α additional energy. Advance nodes have energy $E_0 \times (1+\alpha)$ where E_0 is the energy of normal nodes. Advance nodes are made cluster head more often than normal nodes because advance nodes have more energy as compared to normal nodes. In SEP, Initial energy is increased by $\alpha \times m$ and hence overall performance/ network life time increases so instability period decreases.

$$P_{nor} = \frac{P_{opt}}{1 + m.\alpha} \quad (1)$$

$$P_{adv} = \frac{P_{opt}}{1 + m.\alpha}(1 + \alpha)$$

SEP Routing Protocol

SEP protocol is an improvement and enhancement of LEACH protocol which uses clustering based routing strategy based on the node heterogeneity of the sensor node in the networks. In this protocol and technique, some of the sensor nodes have high energy they are referred to as the advanced nodes and the probability of the advanced nodes to become CHs is more as compared to the normal nodes and the normal nodes have lower energy as compared to the advanced nodes in the network. SEP strategy uses a distributed method to select a CH in WSNs. It is heterogeneity-aware protocol and CH selection probabilities of nodes are weighted by initial energy of each node compared to the other nodes in WSN. So basically, SEP protocol is based on two levels of node heterogeneity as normal nodes and advanced nodes.

- Let, mix the fraction of total number of nodes n, which are deployed with α times more energy than the others nodes.
- These powerful nodes are as advanced nodes.
- The remaining (1 − m) × n nodes are as normal nodes.
- Probability of normal nodes to become CHs is calculated as:

$$P_{nor} = \frac{P_{opt}}{1 + m.\alpha}$$

- Probability of advanced nodes to become CHs is calculated as:

$$P_{adv} = \frac{P_{opt}}{1 + m.\alpha}(1 + \alpha)$$

P_{opt} is the optimal probability of each node to become CH in the network. In SEP strategy, selection of CH is done randomly on probability basis for each node. Sensor nodes continuously sense data and transmit it to their associated CH and CH transmit that data it to the sink or base station (BS). This system can be further improved by increasing the value of or P. Due to advance nodes with two level of node heterogeneity, SEP strategy results in high stable time period, high network lifetime and high throughput.

Advantages of SEP:

Any identification or global knowledge of energy of sensor node is not required in SEP technique at each selection round of cluster head.

Limitation of SEP:

The cluster head (CH) selection among sensor nodes are not dynamic, which results that nodes that are far away from the powerful nodes will die first.

The Network Lifetime

The network lifetime in this paper is defined as the time from the beginning of the simulation to the time when the last node died. In WSN, the network life is divided into stable and unstable period. Stable period usually means the time from the beginning of the simulation to the time when the first node dies, the unstable period refers to the time from the death of first node to the end of simulation.

If it happened that some nodes begin to die, the network operation may become unstable and unreliable data transferring will occur. Therefore, the longer the stable period is, the better the performance of the network. In LEACH Protocol, cluster heads are responsible not only for communicating with the base station, but for the data fusing. Randomly distributing the nodes and randomly selecting the cluster heads causes some cluster heads die earlier because of the low energy or the long distance to base station. Secondary cluster heads are set for these clusters to be responsible for the communication with common nodes and data fusing, this balances the energy load of cluster heads and avoids premature death of these cluster heads, so the stable period of network lifetime will be prolonged is network lifetime in simulation, simulation results indicates that the network lifetime of the SEP protocol and LEACH Protocol are about the same, the first node died in LEACH Protocol in round 95, the first node died in the SEP Protocol in round 110. When 90% nodes died, the network reliability is extremely reduced and the running is almost meaningless. We may as well to define the time from the simulation beginning to the time 90% nodes died as effective lifecycle, analyzing from figure 6, we know that the effective lifecycle of the improved algorithm is longer 9% than that of LEACH protocol. The percentage of stable period of lifecycle in LEACH protocol is 28%, the one in the SEP protocol is 43%, the percentage of stable period of lifecycle in improved algorithm increases 15%. This indicates that the running performance of SEP protocol is much better than that of LEACH Protocol. The analysis of simulation results is consistent with the theoretical analysis.

Conclusion and Future work

In this paper, we scrutinize the up-to-date research on sensor network routing and categorize the common routing algorithms and define the current algorithms in detail and particularize the pros and shortcomings of them. The conventional hierarchical routing algorithm LEACH is scrutinized and deliberated. The amended SEP algorithm is recommended. The amended SEP algorithm is planned by setting different initial energy and the residual energy is efficaciously prolonged to the first node. From Fig.6 it can be seen that the first node of the LEACH protocol is faster than the SEP node, which is more stable than the SEP protocol. This is due to the SEP protocol using the weighted cluster head selection method, the initial energy of the advanced node becomes higher and higher, and thus the time of death will be longer. Compared with the LEACH protocol, the SEP protocol is extended, and the throughput is also increased.

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