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A Comparative Study on Cluster Routing Based on leach in wireless sensor network

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Abstract - *In Wireless Sensor Network Because of the lack of power source it is become essential to improve the energy efficiency and enhance the life time of the sensor node. The most targeting work for energy improvement have been done on the basis of cluster routing WSN is an developing technology which has an huge scope of research and development. Clustering is the technique which balances the load on sensor network and reduces energy dissipation. LEACH is one of the self-organized clustering routing protocols which will be explored and modified. This paper is to provide detail of some LEACH improved versions and compares some features of LEACH protocol variants.*

Key Words: Wireless Sensor Network, Hierarchical routing, cluster based routing protocol, LEACH, cluster-head (CH),cluster members.

1. INTRODUCTION

A Wireless Sensor Networks (WSNs) is considered as one of the most powerful technologies in 21st century. Recent improvement in Micro-electronic-mechanical-systems and wireless communication system, tiny, cheap and smart sensor nodes collaborated with wireless links and the internet deployed in physical area which provide many opportunities in several applications, for instance battle field surveillance, environment monitoring, and health care applications.

WSN consists of manifold sensor nodes, these nodes have low storage capability and limited battery life which dies due to the computation and transmission of data. It is not feasible to replace these batteries due to their location in remote areas

WSN is a special kind of non-infrastructure networks capable of wireless communication having large number of low-cost sensor nodes with limited power and multi-functional capability WSN provides flexibility of adding or removing nodes in the network. Unlike traditional wireless sensor networks like MANETs, WSN has unique characteristics as follows [1]: Dynamic Network Topology, Application Specific, and Energy constrained and Self-configurable.

1.1 Cluster based hierarchical routing protocol

Clustering is the technique which balances the load on sensor network and reduces energy dissipation. Clustering Parameters: Number of clusters, Intracluster communication, Nodes and CH mobility, Nodes types and roles, Cluster formation methodology, Cluster-head selection, Algorithm complexity, Multiple levels, Overlapping.

As the need for efficient use of WSNs on large regions increased in the last decade dramatically, more specific clustering protocols were developed to meet the additional requirements. The most significant and widely used representatives of these focused on WSN clustering protocols (LEACH, EEHC, and HEED) they are all probabilistic in nature and their main objective was to reduce the energy consumption and prolong the network lifetime. Some of them follow a random approach for CH election whereas others (like HEED and similar approaches) follow a hybrid probabilistic methodology.

2. LEACH : CLUSTER BASED HIERARCHICALROUTING PROTOCOL

LEACH (Low-Energy Adaptive Clustering Hierarchy) is routing protocol use a clustering method to transmit data in order to get advantage on reduction of energy consumption. Typical hierarchical clustering routing protocol, which adopts distributed clustering algorithm where cluster-head rotation method, data aggregation, and data fusion technologies effectively improves the lifetime of network.

2.1 Formation of Clusters in LEACH

The LEACH network has two phases: the set-up phase and the Steady-state for data transmission.

The Set-up Phase

In this phase CH is select, On the basis of threshold function T (n) value select CH .mostly T(n) values are between the 0 and 1. If energy value is less than its become

member of cluster and which node have more energy then its became CH

Stochastic Threshold

$$T(n) = \begin{cases} p/\left(1 - p\left(r \bmod \frac{1}{p}\right)\right), n \in G \\ 0 \qquad\qquad\qquad\qquad \text{Other wise} \end{cases}$$

Where P is the cluster-head probability G is the set of nodes that never be chosen as cluster-head nodes before 1/p round.

After the selection of cluster head nodes, each cluster-head node will send information via CDMA code to other nodes and normal nodes will join the corresponding cluster-head nodes. Then the cluster head nodes use TDMA to provide data transmission time for every node connected to them.

The Steady-state

In this phase CHs is gathering information and data which is sensed by the cluster member and then this information is transmit to the base station by CH.

In this stage data aggregation and data fusion is done by the CH

Fig -1: leach phases

3. LEACH'S MODIFIED PRTOCOLS

3.1. LEACH-C (Centralized Low Energy Adaptive Clustering Hierarchy):

Centralized LEACH has steady-state same as basic LEACH protocol but varies in set-up phase. The cluster head nodes are chosen by base station. Each node send its current location and energy level to the base station and the base station uses this global knowledge via GPS or other tracking methods to produce better clusters require less transmission energy.

LEACH-C causes better distribution of cluster head nodes in the network. But LEACH-C requires current location information of all nodes using GPS which is not robust.

3.2. LEACH-F (Fixed number of cluster Low Energy Adaptive Clustering Hierarchy):

Like LEACH-C protocol, this protocol uses centralized approach for cluster formation. Once the cluster formation process is done, then there is no re-clustering phase in next round. only rotation of cluster head nodes within its clusters. Steady-state is same as classical LEACH once clusters are formed and nodes cannot adjust their behavior on node .

3.3. LEACH-B(Balanced Low Energy Adaptive Clustering Hierarchy):

In LEACH-B for the cluster formation purpose it uses the de-centralized algorithms in which each sensor node only knows about its own position and the destination node position where actually the information will going to receive, and it does not know about any other sensor node position. In LEACH-B, Cluster formation and data transmission are done with the help of multiple accesses to different nodes. Compared to LEACH efficiency of LEACH-B is much higher.

3.4. TL-LEACH (Two level Low Energy Adaptive Clustering Hierarchy):

TL-LEACH protocol works in two-level hierarchy. The aggregated data from each cluster head is collected by a cluster head lies between cluster heads and the base station, instead of sending directly to the base station. TL-LEACH improves energy efficiency by using a cluster head node as relay node in between cluster head nodes.

3.5. LEACH-E (Energy Low Energy Adaptive Clustering Hierarchy):

LEACH-E protocol would improve the CH selection process compared to LEACH protocol. The LEACH-E is divided into different round that is same as LEACH protocol. In the first round all the sensor nodes would having the same probability to be CH of the cluster. After the first round of transmission the residual energy of each node would got different and based on this, the node who would have the high residual energy would be chosen as CH of the cluster and other nodes in the cluster would dying.

Became the cluster member who would having the less energy

3.6. MH-LEACH (Multi-Hop Low Energy Adaptive Clustering Hierarchy):

In LEACH protocol, the cluster head nodes send data to the base station directly irrespective of distance between them. This is disadvantage of the LEACH protocol. This can be overcome by the help of MLEACH in which the CH sends the data to the sink using the other CHs as relay stations.

This protocol adopts an optimal path between cluster head and the base station LEACH-M (Mobile Low Energy Adaptive Clustering Hierarchy) LEACH-M protocol was proposed for mobility issue in LEACH protocol. Its provides mobility to t non-cluster head nodes and cluster head nodes in setup and steady state phase .CHs are being select on the basis of minimum mobility of the node and lowest attenuation mode of the node. After selection CHs broadcast his states the messages with in the range of transmission.

3.7. LEACH-M (Mobile Low Energy Adaptive Clustering Hierarchy):

LEACH-M was proposed to solve mobility issue which is an important issue in LEACH protocol. Its provides mobility to t non-cluster head nodes and cluster head nodes in setup and steady state phase .CHs are being select on the basis of minimum mobility of the node and lowest attenuation mode of the node. After selection CHs broadcast his states the messages with in the range of transmission

3.8 I-LEACH (Improved Low Energy Adaptive Clustering Hierarchy):

In I-LEACH protocol two main functions are 1) Detection of Twin nodes and 2) Assignment of Sub-Cluster Head (SCH) nodes. Two nodes distance between two node is less in network its called as twin node.

Twin nodes would sense the same information. Hence it is necessary to keep one of the two twin nodes in sleep mode until the first node would run out of energy.So I-LEACH has uniform distribution of CH in network so that it doesn't run out of energy when longer distance transmission takes place this protocol uses threshold method for handling number of cluster members for each cluster head in the network at a time

3.9. LEACH-A (Advanced Low Energy Adaptive Clustering Hierarchy):

In LEACH protocol cluster head node consumes more energy than normal nodes. Advanced-LEACH protocol, a heterogeneous protocol used to reduction chance of failure nodes and for extending the time interval before the death of the first node.

Each sensor knows the starting of each round using synchronized clock. Let n be the total number of nodes and m be the fraction of n that have energy more than other nodes called CGA nodes (nodes selected as gateways or cluster heads). The rest of (1-m)*n nodes act as normal nodes.

3.10 V-LEACH

Death of a CH and network to stop working. To prevent this V LEACH protocol consists of a vice CH along with a CH in each cluster that takes the role of CH when CH dies. In this way, this protocol decreases overhead of selecting new CH each time when a CH dies and the data will always reach to the base station.

4. CONCLUSIONS

In wsn node is so far and in remote area and the battery size is small because of small size of node so save energy to good performance This proposed system id used to increase the life time of wireless sensor network ,cluster and cluster head and because of fix cluster in the setup phase is uses less energy . node energy is high so possibility of data losses is less so get perfect information and cost also reduce of the network

About LEACH and we able to distinguish various drawbacks of this protocol along with its advantages. During survey we studied various improved version of LEACH protocol which gives various beneficial result in many ways which we are able to learn when we do the comparative study of various improve version of LEACH with the fundamental one. Finally, it can be concluded from the given survey that for an energy-efficient and extended wireless sensor networks, still it is needed to find more efficient, scalable and robust clustering scheme for better result.

Table -1: Performance comparison between LEACH protocol variants

Clustering Routing Protocol	Year	Mobility	Scalability	Self organization	Distributed	Hop Count	Homogeneous	Use of Location Information
LEACH	2002	Fixed BS	Limited	Yes	Yes	Single Hop	Yes	No
LEACH-C	2002	Fixed BS	Good	Yes	No	Single Hop	Yes	Yes
LEACH-F	2002	Fixed BS	Limited	No	No	Single Hop	Yes	Yes
LEACH-B	2003	Fixed BS	Good	Yes	Yes	Single Hop	Yes	Yes
TL-LEACH	2005	Fixed BS	Very Good	Yes	Yes	Single Hop	Yes	Yes
LEACH-E	2007	Fixed BS	Very Good	Yes	Yes	Single Hop		Yes

MH-LEACH	2007	Fixed BS	Good	Yes	Yes	Multi Hop	Yes	Yes
LEACH-M	2008	Mobile BS and Nodes	Very Good	Yes	Yes	Single Hop	Yes	Yes
I- LEACH	2009	Fixed BS	Very Good	Yes	Yes	Single Hop	Yes	Yes
LEACH-A	2010	Fixed BS	Good	Yes	Yes	Single Hop	No	No
Cell-LEACH	2012	Fixed BS	Very Good	Yes	Yes	Multi Hop	Yes	Yes
V- LEACH	2013	Fixed BS	Very Good	Yes	Yes	Single Hop	Yes	Yes

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