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Energy Efficient Cluser Based Leach Protocol Using WSN

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Abstract— Wireless sensor network systems will enable the reliable monitoring of a variety of environments for both civil and military applications. In this paper, we look at communication protocols, which can have significant impact on the overall energy dissipation of these networks. We propose LEACH (Low-Energy Adaptive Clustering Hierarchy), a clustering-based protocol that utilizes randomized rotation of local cluster base stations (cluster-heads) to evenly distribute the energy load among the sensors in the network. LEACH uses localized coordination to enable scalability and robustness for dynamic networks, and incorporates data fusion into the routing protocol to reduce the amount of information that must be transmitted to the base station.

Keywords— Wireless sensor network (WSN), LEACH protocol, clustering protocol

I. INTRODUCTION

A wireless sensor network (WSN) consists (1) of a number of sensor nodes which can communicate wirelessly. A wireless sensor node usually comprises of a microcontroller, a low power radio transceiver, sensors, and a battery power. These nodes are to monitor a given set of environmental conditions, such as temperature, sound, light, or the movement of chemicals or objects or vibrations. WSNs are often installed in very harsh environmental conditions where he human monitoring is very risky, such as in high alpine environments, forcing them to run unattended for most of the time. These nodes continuously sense the environment, communicate events to each other and route their information to a remote base station. The most important challenge in achieving this goal is the power constraint on these small, low cost sensor nodes.

It is a new (2) information acquisition and processing technology, it does not require any of the default network. A large number of randomly sensor nodes formed self-organization network by wireless communication. It has a network of self-organization, network topology reconfiguration flexibility, and many other advantages, has a very broad application prospects and high academic value. In wireless networks, inexpensive sensor nodes, but extremely limited node energy and environmental complexity of network applications, the maximum degree of reduction of communication energy consumption of sensor nodes is one of the main researches in sensor networks.

II. LOW ENERGY ADAPTIVE CLUSTERING HIERARCHY (LEACH)

LEACH is the first (3) and most popular energy-efficient hierarchical clustering algorithm for WSNs that was proposed for reducing power consumption. In LEACH, the clustering task is rotated among the nodes, based on duration. Direct communication is used by each cluster head (CH) to forward the data to the base station (BS). It uses clusters to prolong the life of the wireless sensor network. LEACH is based on an aggregation (or fusion) technique that combines or aggregates the original data into a smaller size of data that carry only meaningful information to all individual sensors. LEACH divides the a network into several cluster of sensors, which are constructed by using localized coordination and control not only to reduce the amount of data that are transmitted to the sink, but also to make routing and data dissemination more scalable and robust. LEACH uses a randomize rotation of high-energy CH position rather than selecting in static manner, to give a chance to all sensors to act as CHs and avoid the battery depletion of an individual sensor and dying quickly. The operation of LEACH is divided into rounds having two phases each namely (i) a setup phase to organize the network into clusters, CH advertisement, and transmission schedule creation and (ii) a steady-state phase for data aggregation, compression, and transmission to the sink. LEACH is completely distributed and requires no global knowledge of network. It reduces energy consumption by (a) minimizing the communication cost between sensors and their cluster heads and (b) turning off non-head nodes as much as possible. LEACH uses single-hop routing where each node can transmit directly to the cluster-head and the sink. Therefore, it is not applicable to networks deployed in large regions. Furthermore, the idea of dynamic clustering brings extra overhead, e.g. head changes, advertisements etc., which may diminish the gain in energy consumption. While LEACH helps the sensors within their cluster dissipate their energy slowly, the CHs consume a larger amount of energy when they are located farther away from the sink. Also, LEACH clustering terminates in a finite number of iterations, but does not guarantee good CH distribution and assumes uniform energy consumption for CHs.

It is one (4) of the earliest clustering routing protocols for WSNs to increase the lifespan of network. LEACH is a self-organizing protocol that distributes energy load equally among all the sensors of the network. In LEACH, nodes form clusters and a CH is elected from each cluster. LEACH chooses high energy sensor node CH and rotates this role

among all nodes of the network.. LEACH also performs data fusion to compress the amount of data being sent from cluster to base station. Thus LEACH reduces energy dissipation and increases network lifetime. For each round, sensors elect themselves as CH with certain probability. The status of these CHs is broadcasted within the network. Each sensor node selects its CH by choosing the one which requires minimum communication energy to send data to. After the formation of a cluster, CH creates a schedule for the nodes to transmit data. In this way, nodes transmit data to the CH in their allocated time and are in sleep condition for the rest of the time. So, the energy dissipation of individual sensor node is minimized in this manner. When the cluster-head receives all the data from nodes within a cluster, it aggregates that data and sends compressed data to the base station. In this way, energy dissipation of the whole network is reduced. Similarly, being a CH, the energy of that node drains fast. LEACH has no fixed number of CH and a CH is self-elected in every round. For a node to become CH, depends on energy of that node. So, node with higher remaining energy acts as CH for that round.

2.1 Operation of Leach:

The operation of (4) LEACH is broken into rounds. Each round consists of two phases, a set-up phase and a steady-state phase. In set-up phase, the clusters are organized and in steady-state phase data is transmitted to the base station. Generally steady-state phase is longer than set-up phase to minimize overhead.

2.2. Advertisement Phase:

At the (5) beginning, when clusters are formed, each node decides whether it should become a CH for the current round or not. This decision is taken by determining the suggested percentage of CH and number of times a node has been a CH. A node n makes a decision by taking a number between 0 and 1 randomly. If the number is less than a certain threshold T(n), the node becomes CH for the current round. The threshold is determined as:

$$T(n) = \begin{cases} \dfrac{P}{(1 - P * [r \bmod (1/P)])} & \text{if } n \in G \\ 0 & \text{otherwise} \end{cases}$$

Where G is set of nodes that have not been selected as CHs in previous 1/P rounds, P is suggested percentage of CH, r is current round. By using this threshold, each node has the chance of becoming a CH at some stage within 1/P rounds. During initial round zero (r=0), each node has the probability P of becoming a CH. Similarly, if a node becomes CH in round zero, it cannot become a CH for the next 1/P rounds. The node that has elected itself as CH for the current round, broadcasts an advertisement message to all nodes within the network. The non-CH nodes have to keep their receivers on. This advertisement is received by non-CH nodes. After receiving this message, each sensor node decides to join a certain cluster for the current round. This decision is taken according to the strength of received signal. So, the non-CH will join a CH whose received signal strength is larger. In this way, the energy required for communication between non-CH nodes and CHs nodes is less. In certain cases where received signal strength is same for more than one CH, a random CH is selected.

2.3. Cluster Set-Up Phase:

When a node (5) decides to join a cluster, it must inform the cluster-head that it wants to be a member of that cluster. During this phase, the CHs have to keep their receivers on.

2.4. Schedule Creation:

After receiving (5) message from all nodes that would like to join that cluster, the CH creates a TDMA schedule based on number of nodes and informs the nodes when to transmit data.

2.5. Data Transmission:

Once the clusters (6) are created and the TDMA schedule is fixed, data transmission can begin. Assuming nodes always have data to send, they send it during their allocated transmission time to the cluster head. This transmission uses a minimal amount of energy (chosen based on the received strength of the cluster-head advertisement). The radio of each non-cluster-head node can be turned off until the node's allocated transmission time, thus minimizing energy dissipation in these nodes. The cluster-head node must keep its receiver on to receive all the data from the nodes in the cluster. When all the data has been received, the cluster head node performs signal processing functions to compress the data into a single signal. For example, if the data are audio or seismic signals, the cluster-head node can beam form the individual signals to generate a composite signal. This composite signal is sent to the base station. Since the base station is far away, this is a high-energy transmission.

2.6. Advantages of Leach:

- LEACH is (5) completely distributed, requiring no control information from the base station and the nodes do not require knowledge of the global network in order for the LEACH to operate.
- Node serves as CH once in a round to distribute the load equally.
- TDMA prevents CHs from unnecessary collisions. 4. Excessive energy dissipation is prevented by communicating only in the allocated time.

2.7. Disadvantages of Leach:

- It performs (5) single hop communication which is not applicable to large networks because of excessive energy dissipation.
- Leach does not ensure real load balancing for nodes having different initial energy because CH is selected by probability and not seeing its initial energy.
- The idea of dynamic clustering brings extra overhead.

III. CBEEN (CLUSTER BASED ENERGY EFFICIENT SENSOR NETWORK PROTOCOL)

Routing protocols (4) for wireless sensor networks can be characterized into two classes, proactive and reactive protocols. LEACH protocol is considered as proactive protocol since it refers reports to the BS periodically. In reactive protocols, when an event of attentiveness occurs, it is reported to the BS. Reactive protocols are mostly used for time critical applications where speedy response to fluctuations in the sensed parameters is mandatory. Cluster based Energy Efficient Sensor Network Protocol (CBEEN) is a reactive protocol considered for time critical applications. In CBEEN, nodes are arranged in a hierarchical clustering arrangement in which assured nodes act as CH (first or second level). After a CH is selected, the user sets features for it. When the CH receives these features, it broadcasts the attributes (Hard Cluster (HC) and Soft Cluster (SC) values) to all supporter nodes of the cluster. The Sensor nodes sense the data and transmit only when the sensed data beats HC. HC is the minimum value above which values are noted. Sensed value (SV) is an internal variable which stores the transferred sensed value. The sensor again senses data and when its value beats the SC, which is the minimum change in sensed significance, it starts transmitting data. Also CBEEN uses a homogeneous environment. In this way, CBEEN saves energy because it only transfers data when HC is achieved. SC further reduces the number of transmission, which else would have arisen due to little or no change to level of sensed attributes. Since CH also performs superfluous computations, its energy consumption is more than other nodes. This problem is resolved by giving equal chance to each node to act as CH for a fixed cluster period. No transmission from nodes to CH occurs if the sensed value is under HC, so, the CH will not be aware of expiry of a sensor node. By giving smaller value to SC on price of high energy due to frequent communication, a pure scenario of the network can be obtained. Similar to LEACH, each node in the cluster is given a time slot for data communication using TDMA schedule shows the 2 tier clustering topology in CBEEN. But here two forms of cluster are castoff. Its efficiency is improved on behalf of these thresholds. Soft threshold is castoff to on or off the sensing node while hard threshold is activated while sensing value is being changed. Here two level of CH are being used.

IV. CLUSTERING

Clustering (7) provides an effective method for prolonging the lifetime of a WSN. Notice that the BS is ordinarily located far away from the sensing area. Previous researches have shown that multi-hop inter-cluster communication mode is ordinarily more energy efficient because of the characteristics of wireless channel. Thus, it is better to let CH cooperate with every other to forward their data to the BS. However, they rarely consider the problem in multi-hop sensor networks. As shown in Figure 4.1, when CH cooperate with each other to forward their data to the BS, the CH closer to the BS are burdened with heavier relay traffic and tend to die much faster, leaving areas of the network uncovered.

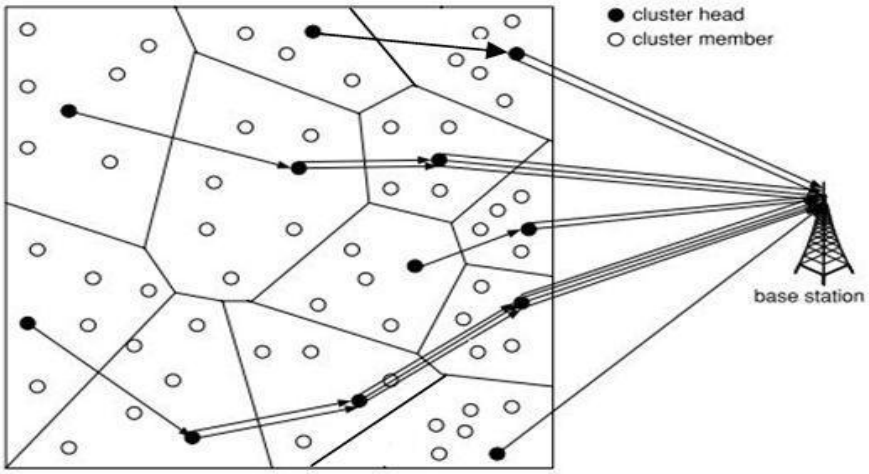

Figure 4.1: Multi-hop cluster hierarchy in WSN

Clustering (7) is useful for improving energy efficiency, and it can be done in two kinds of networks: homogenous and heterogeneous. There are three common types of resource heterogeneity in sensor nodes: computational heterogeneity, link heterogeneity, and energy heterogeneity. Energy heterogeneity means that the heterogeneous nodes are line powered, or their batteries are replaceable. This is the most important heterogeneity because both computational heterogeneity and link heterogeneity will consume more energy resource. Our system model is based on a WSN which consists of a BS and a set of heterogeneous sensor nodes. Placing few heterogeneous nodes in WSN is an effective way to increase network lifetime.

V. CEP (CLUSTER ELECTION PROTOCOL)

In real life, sensor (4) node is not able to keep energy uniformity. Therefore, the perception of heterogeneity is introduced. Cluster Election Protocol (CEP) heterogeneous alert routing protocol which is proposed for the efficient consumption of energy. In CEP, each node has weighted probability to convert CH which depends upon the initial energy of the node.

5.1 Heterogeneous Network:

In such networks, nodes have dissimilar amount of initial energy. 'm' describes a fraction of total nodes 'n', which have 'a' times more energy other nodes. These larger energy nodes are called advance nodes and the remaining nodes having energy (1-m)*n are called normal nodes.

5.2 Optimal Clustering:

In case of heterogeneous (4) nodes, LEACH creates a big unstable region. This is because all remaining advanced nodes have nearly same amount of energy, so, the process to elect CH becomes unstable and no CH is elected and advance nodes become idle. CEP improves the stable region using some fraction of advanced nodes 'm' and some added energy factor 'a' to differentiate normal nodes from advance nodes. In CEP, the advanced nodes have more chances to become CH than normal nodes. In heterogeneous network with advance and normal nodes, the a priori setting of P_{opt} is not affected but the total energy of the system varies. If E_0 is initial energy of normal node then (1+a) E_0 becomes initial energy of advanced nodes. So, initial energy of heterogeneous system is given below:

$n(1-m)\ E_0 + nm\ E_0(1+a) = n\ E_0\ (1+am)$

Energy of the whole system is increased by an amount (1+am), if;

- Normal node has the probability to become CH once in $1/[\ P_{opt} * (1+am)]$ rounds.
- Advance node has the probability to become CH (1+am) times in $1/[\ P_{opt} * (1+am)]$ times.
- $n * P_{opt}$ is average number of CH per round.

VI. CONCLUSION

In this paper, we described LEACH, a clustering-based routing protocol that minimizes global energy usage by distributing the load to all the nodes at different points in time. LEACH outperforms static clustering algorithms by requiring nodes to volunteer to be high-energy cluster-heads and adapting the corresponding clusters based on the nodes that choose to be cluster-heads at a given time. At different times, each node has the burden of acquiring data from the nodes in the cluster, fusing the data to obtain an aggregate signal, and transmitting this aggregate signal to the base station. LEACH is completely distributed, requiring no control information from the base station, and the nodes do not require knowledge of the global network in order for LEACH to operate.

Distributing the energy among the nodes in the network is effective in reducing energy dissipation from a global perspective and enhancing system lifetime.

REFERENCES

[1] Vivek Katiyar, Narottam Chand, Gopal Chand Gautam "Improvement in LEACH Protocol for Large-scale Wireless Sensor Networks" PROCEEDINGS OF ICETECT 2011

[2] LIU Zhi-jun, LI La-yuan "Based on Energy Balance LEACH-DC Protocol Design.

[3] Nishanth Thimmegowda, Monica R Mundada "Clustering in Wireless Sensor Networks: Performance Comparison of EAMMH and LEACH Protocols using MATLAB.

[4] A.Haider, M. M. Sandhu, N. Amjad, S. H. Ahmed, M. J. Ashraf, A. Ahmed, Z. A. Khan, "REECH-ME: Regional Energy Efficient Cluster Heads based on Maximum Energy Routing Protocol with Sink Mobility in WSNs" ISSN 2090-4304 Journal of Basic and Applied Scientific Research *J. Basic. Appl. Sci. Res.*, 4(1)200-216, 2014

[5] A.Haider, M. M. Sandhu, N. Amjad, S. H. Ahmed, M. J. Ashraf, A. Ahmed, Z. A. Khan, "DREEM-ME: Distributed Regional Energy Efficient Multi-hop Routing Protocol based on Maximum Energy with Mobile Sink in WSNs" ISSN 2090-4304 Journal of Basic and Applied Scientific Research *J. Basic. Appl. Sci. Res.*, 4(1)289-216, 2014

[6] Wendi Rabiner Heinzelman, Anantha Chandrakasan, and Hari Balakrishnan "Energy-Efficient Communication Protocol for Wireless Micro sensor Networks" Proceedings of the 33rd Hawaii International Conference on System Sciences – 2010.

