Improvement in Life of Routing Protocol by Styling an Improved Cluster Head theme using LEACH

Megha Shah
Department of Computer Science & Engineering, Sat Priya Group of Institutions, Rohtak (Haryana), India.

Tamanna
Assistant Professor, Department of Computer Science & Engineering, Sat Priya Group of Institutions, Rohtak (Haryana), India.

Abstract – In this paper we introduce a Low Energy Adaptive Clustering Hierarchy ("LEACH") protocol which is a TDMA-based MAC protocol, which is integrated with clustering and a simple routing protocol in wireless sensor networks (WSNs). The goal of LEACH is to lower the energy consumption required to create and maintain clusters in order to improve the life time of a wireless sensor network. 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.

Index Terms – LEACH, MSN, WSN, Base Station (BS)

1. INTRODUCTION

Wireless networking is an emerging technology that allows users to be able access a broad range of information and services while user are mobile. Wireless networks are playing a major role in the area of communication. Now we are using wireless networks antecedently, the real distinction between wireless and wired networks was only in communication channel. There exist physical medium in wired networks, whereas on the opposite facet physical medium physical medium doesn't exist on the wireless networks. Wireless networks became very popular in different applications considering the following factors: ease of installation, reliability, cost, bandwidth, total required power, security and performance of network. All networks were however based on fixed infrastructures.

1.1. Introduction to Wireless Sensor Networks

A wireless sensor and actuator network is a collection of small randomly dispersed devices that provide three essential functions [9]; the ability to monitor physical and environmental conditions, often in real time, such as temperature, pressure, light and humidity; the ability to operate devices such as switches, motors or actuators that Control those conditions; and the ability to provide efficient, reliable communications via a wireless network. Since they are designed for low traffic monitor and control applications, it is not necessary for them to support the high data throughput requirements that data networks like Wi-Fi require. Typical WSN over-the-air data rates range from 20 kbps to 1 Mbps. Consequently they can operate with much lower power consumption, which in turn allows the nodes to be battery powered and physically small. WSNs are typically self-organizing and self-healing. Self-organizing networks allow a new node to automatically join the network without the need for manual intervention. Self-healing networks allow nodes to reconfigure their link associations and find alternative pathways around failed or powered-down nodes. How these capabilities are implemented is specific to the network management protocol and the network topology, and ultimately will determine the network's flexibility, scalability, cost and performance. Wireless sensor networks use three basic networking topologies; point-to-point, stars and cluster or cluster-tree networks.

1.2. Three types of nodes used in the WSN

1.2.1. Micro-sensor nodes (MSNs)

The MSNs can be application-specific sensor nodes (e.g., temperature sensor nodes (TSNs), pressure sensor nodes (PSNs), and video sensor nodes (VSNs)) and they constitute the lower tier of the network. The MSNs are small and low-cost. The objective of an MSN is very simple Once triggered by an event it starts to capture live information (e.g., video), which it sends directly to the local AFN. For each cluster of MSNs, there is one AFN, which is different from an MSN in terms of physical properties and functions.

1.2.2. Aggregation and forwarding nodes (afns):-

Data aggregation (or "fusion") for data flows from the local cluster of MSNs, and forwarding (or relaying) the aggregated information to the next hop AFN (toward the base-station) [19].An AFN also serves as a relay node for other AFNs to carry traffic toward the base-station. Although an AFN is expected to be provisioned with much more energy than an MSN, it also consumes energy at a substantially higher rate (due to wireless communication over large distances). Consequently, an AFN has a limited lifetime.

1.2.3. Base-station (BS):-

The sink node for data streams from all the AFNs in the network. In this investigation, we assume that there is sufficient energy resource available at the base station and thus there is no energy constraint at the base-station [19]. In summary, the main functions of the lower tier MSNs are data acquisition and compression while the upper-tier AFNs are used for data fusion and relaying information to the base-station.

1.3. Energy-Efficient Routing Protocols For WSN

Low-Energy Adaptive Clustering Hierarchy (LEACH), is a clustering-based routing protocol for wsns proposed by Heinzelman, et al. (Heinzelman, 2000)[6] This communication protocol is developed to reduce the overall energy waste for networks. It deploys a randomized rotation of cluster-heads techniques. The operation of LEACH is decomposed into rounds; and each round start with set-up phase, where a sensor node randomly chooses a number between 0 and 1, and the network will decide whether to select this sensor as cluster-head; and ends with steady-state phase, where data is transferred to the base stations. The authors compared the total energy dissipated in WSN system using LEACH protocol with direct data transmission and minimum-transmission-energy (MTE) routing protocol. Results show that LEACH reduces communication energy dissipation by as much as 8 times compared with the other two protocols.

2. LITERATURE REVIEW

A lot of research work has already been done in this field to improvise security in the data while the transfer. Some of the reviews are as follows:

- Heinzelman, et al. (Heinzelman, 2000[1]"Low-Energy Adaptive Clustering Hierarchy (LEACH), is a clustering-based routing protocol for wsns".
- Younis and Fahmy (Younis, et al. 2004)[2] " a hybrid, energy-efficient approach for distributed clustering in ad-hoc sensor networks named HEED. This protocol is intended to improve the network performance in network lifetime,scalability, and load balancing".
- Muruganathan et al. (Muruganathan, 2005)[3] "a centralized routing protocol called Base-Station Controlled Dynamic Clustering Protocol (BCDCP) to enhance the energy efficiency in WSN design in order to improve the life spanSonalsharma, jitendrasinghyadav, parshantsharma performed a work,"
- Lindsey et al. (Lindsey, 2005) [4]"Power-Efficient Gathering in Sensor Information Systems (PEGASIS) is an enhancement of LEACH. It aims at increasing the node lifetime, as well as reducing the bandwidthconsumed in communication".
- Manjeshwar et al. (Manjeshwar, 2001) [5] "a Threshold sensitive Energy Efficient sensor Network protocol (TEEN) of increasing energy efficiency in for reactive networks, which response immediately to environment ".
- Manjeshwar (Manjeshwar, 2002) [6] "a hybrid protocol named APTEEN, and modification of TEEN, for efficient routing and comprehensive information retrieval".
- Li et al. (Li, 2005)[7] "an Energy-Efficient Unequal Clustering (EEUC) mechanism in order to solve the hot spots problem in cluster-based WSN, where cluster-heads closer to the base station suffers from heavy load of traffic"
- Chen et al. (Chen, 2002) [8]"SPAN is another a power saving technique for WSN. This protocol reduces energy consumption by involving a random algorithm where sensors can decide whether to turn into an idle state, or act as a coordinator which stay awake continuously and form a network backbone used to forward messages".

2.1. Details Experimental

2.1.1. Materials and Procedures

- In my dissertation work we used MATLAB platform for implementation of my proposed work that provide a good programming environment. The dataset which we have taken also describe there on that dataset we implement our algorithm. The operation of LEACH is divided into rounds. Each round begins with a set-up phase when the clusters are organized, followed by a steady-state phase when data are transferred from the nodes to the cluster head and on to the BS, as shown in below figure. This figure show the cluster formation in Leach. For the development of LEACH, we made some assumptions about the sensor nodes and the underlying network model. For the sensor nodes, we assume that all nodes can transmit with enough power to reach the BS if needed, that the nodes can use power control to vary the amount of transmit power, and that each node has the computational power to support different MAC protocols and perform signal processing functions. These assumptions are reasonable due to technological advances in radio hardware and low-power computing. For the network, we use a model where nodes always have data to send to the end user and nodes located close to each other have correlated data.
- In LEACH, the nodes organize themselves into local clusters, with one node acting as the cluster head. All

non-cluster head nodes transmit their data to the cluster head, while the cluster head node receives data from all the cluster members, performs signal processing functions on the data (e.g., data aggregation), and transmits data to the remote BS. Therefore, being a cluster head node is much more energy intensive than being a non- cluster head node. If the cluster heads were chosen a priori and fixed throughout the system lifetime, these nodes would quickly use up their limited energy. Once the cluster head runs out of energy, it is no longer operational, and all the nodes that belong to the cluster lose communication ability. Thus, LEACH incorporates randomized rotation of the high-energy cluster head position among the sensors to avoid draining the battery of any one sensor in the network. In this way, the energy load of being a cluster head is evenly distributed among the nodes.

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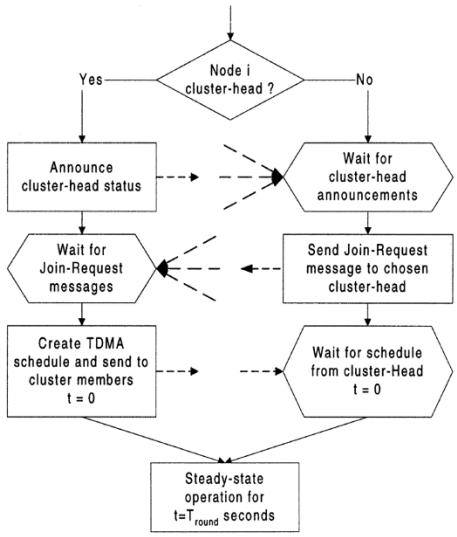

Figure 1: block diagram of my dissertation work

In this proposed work following research objectives will be achieved

- Study different routing protocols in Wireless sensor network
- Implementation of Existing Leach Protocol
- Design the improvement parameters to decide the cluster head
- Increase the lifetime of each node by using collaborative techniques and as a result the network lifetime will be increased.
- Analysis the network life time in terms of live nodes and packet transferred.

3. RESULTS AND DISCUSSION

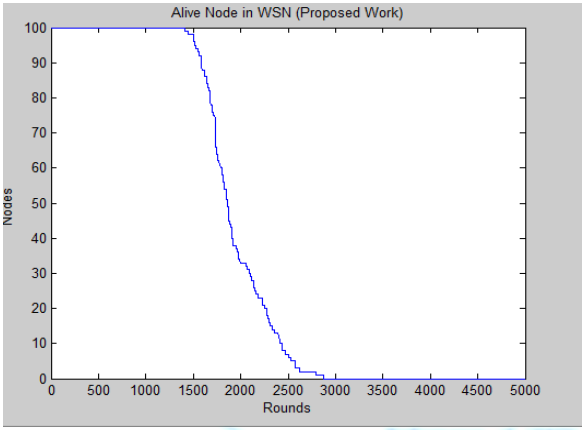

Figure 2: -The figure shows the active nodes for given round

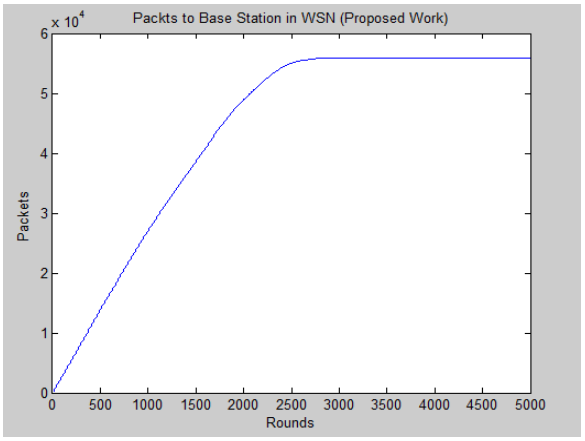

Figure 3:-The figure shows the packets transmitted to base station

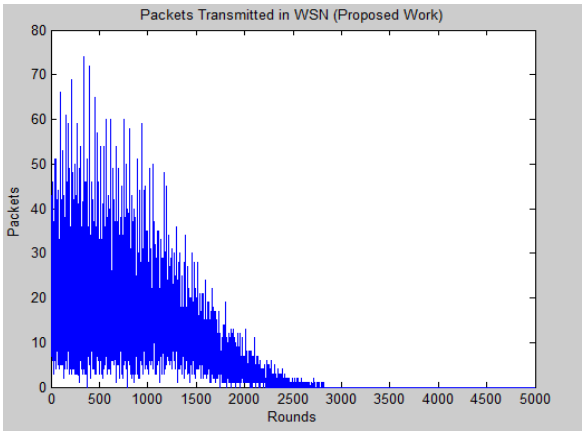

Figure 3:-The figure shows Packets transmitted over number of rounds

4. CONCLUSIONS

LEACH is one of the most well-known routing protocols in terms of energy-efficiency. The reason why it is extremely energy efficient is that it evenly distributes the energy load among the sensors in the WSNs. This is one of the earliest proposed WSN energy-efficient routing protocol, and numerous of other communication protocols proposed for reducing energy dissipation in WSNs are inspired by LEACH, or consider it as a benchmark. However, there are still some issues to be addressed for LEACH, such as overhead and hot spot problem.

The characteristic that differentiates LEACH and HEED is that HEED does not select cluster-heads randomly. HEED outperforms LEACH in terms of saving energy. However, so far HEED is only applicable in single cluster layer network; however, according to the author, this protocol could be extended to multi-level hierarchies.

According to the experiments, BCDCP is especially suitable for large-scale WSN network. However, it is not a widely used protocol. Thus it is hard to evaluate whether this protocol is practical.

PEGASIS has a high performance in saving energy and data aggregation. This is mainly because it eliminates the overheads and reduces the number of transmissions. One of the basic assumptions of PEGASIS is that every sensor in the network is capable to communicate directly with the base station; however, it is not always true. The delay in transmission is another issue of this approach.

TEEN and APTEEN are develop for active WSN where immediate responses are required. The main drawback of TEEN and APTEEN is that since all activities in the network rely on the threshold value, the nodes will not communicate if the threshold values are not received. In this way, the robustness of the network may be influenced.

EEUE is an enhancement of LEACH aiming at solving the hot spot problem. It has a better performance in smaller sized WSN.

SPAN is a position-based protocol. It might be vulnerable to HELLO flood attack since it uses HELLO packets to determine the status of other sensor, namely idle or active.

EECS could be extremely energy efficient in single-hop networks. However, some researchers argue that EECS might not be effective in heavy energy heterogeneous circumstances.

FUTURE SCOPE OF PRESENT WORK

In this work the improvement over the LEACH is proposed that will save the energy while performing a cluster based communication over the network. This work is performed on homogenous network. The work can be extended to work on heterogamous network. The heterogeneity will be in terms of type of sensor nodes, environment and the node parameters.

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