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Enhancing The Throughput Using Sleep Scheduling Mechanism In Wireless Sensor Networks

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***Abstract*- Recent advancement in wireless sensor network has received a significant attention towards it. Wireless Sensor Networks are highly**
. distributed networks of small, low cost, light weighted, wireless sensor nodes deployed in large numbers, connected through a wireless network that gather data from distance environment. These sensor nodes are immobile, non rechargeable with limited energy. So we need to use the available energy in an efficient manner to extend its lifetime. Clustering algorithms have been widely used to reduce energy consumption by sensor nodes. Several solutions were proposed for on this and LEACH-CS proved to extend the lifetime very well by applying sleep scheduling mechanism. But LEACH-CS has a came with a drawback that, throughput which is the essential purpose of wireless of wireless sensor network suffers a dramatic decrease as not all nodes function in the network. In order to overcome this problem we use the property of LEACH-CS and our new method is proposed in this paper by changing the sleep scheduling mechanism of existing LEACH-CS to improve it.

I. INTRODUCTION

Due to the recent advancement in wireless technology and reduced size of motes wireless sensor network attained a very good attention towards it. Wireless sensor network consist of large number of small sized motes which forms a network. They are used to collect reliable and accurate information from distance and hazards environment. It has its applications in various fields like Military Affairs, National Defense, Industrial Control, Environmental Monitor, forest fire detection, Traffic Management, agriculture, Medical Care, and Smart Homes etc. The hardware structure of sensor node consists of four components: 1.sensing unit, 2.processing unit, 3. radio unit, 4. power unit. Sensing unit senses the environment and transfers the sensed data to the processor. Processing unit processes the data compresses it. Radio unit is used to send and receive the processed data between nodes. First three units depend upon the fourth power unit for their functioning. i.e. the power unit supplies the necessary energy for the functioning of sensor nodes. The power unit consists of battery which supplies the power. As the sensor node itself very small in size, the battery of sensor node will be very much small in size and it consist of only a limited charge. The battery of sensor node is mostly not chargeable or irreplaceable. The main purpose of sensor network is to periodically
gather data from remote areas, where each node continuously senses the environment and transfers the data to base station for further analysis. Usually the base station will be located far away from the network
area. As the sensor node consist of only a limited charge, the lifetime of sensor node is also limited and
mostly the battery is irreplaceable or not rechargeable. Hence the protocols must be designed in such a manner to make the sensor nodes to work energy efficiently. Another thing about sensor network is the delivery time of data, since it is important in many applications like battlefield monitoring, medical/security monitoring etc… They require data within a particular time instant. Communication protocols highly affect the performance of wireless sensor networks by an evenly distribution of energy load and decreasing their energy consumption & prolonging their lifetime. Thus, developing energy efficient protocols is a very important for prolonging the lifetime of wireless sensor networks. A lots of research work had been done to evaluate and improve routing protocols in wireless sensor network. LEACH - Low-energy adaptive clustering hierarchy is one of the most popular hierarchical routing protocols for wireless sensor networks. In LEACH, formations of clusters of the sensor nodes are done on the received signal strength. LEACH uses local cluster heads as routers to the sink. The transmission of data is done only through these cluster heads rather than all the sensor nodes in the network. This will save energy as only cluster heads are responsible for transmission of data towards sink. These cluster heads change randomly over time depending on energy dissipation of the sensor nodes.

II. LITERATURE SURVEY

Till now a lot of ideas had been developed based on the concept of clustering method to raise the efficiency of sensor network.

Heinzelman [2] introduced LEACH (Low Energy Adaptive Clustering Hierarchy) - a clustering based single hop communication algorithm. According to his concept of LEACH, the base station randomly selects

the cluster head and the rest of the nodes joins the CH depending upon the strength of the signal it's receiving. Its operation is divided into rounds and each round consists of set-up phase and steady-state phase. During the set-up phase CH gets selected and cluster gets formed. During steady-state phase CH aggregates data and sends it to the BS through 1-hop communication. Once the clusters are formed they are fixed, but the CH are changed for every round based on the remaining energy level of nodes. The specialty is that, the node which is elected before as CH will not be elected until all the remaining nodes in the cluster are selected as CH. Once the clusters are created TDMA schedule is determined and CHs sends the TDMA slots to its members. The nodes send their sensed data in their respective slots to their cluster head.

Even though LEACH has advantages, it lacks towards placement and number of cluster heads being selected since the CHs are selected randomly. Thus to overcome this a centralized idea has been developed based on LEACH [3], which turned out to be LEACH-C (LEACH-Centralized), a protocol which uses a centralized clustering algorithm to select CHs. BS receives and checks the current location and energy level of CHs. Based on it selects the CHs. The rest of the process is same as that of LEACH.

In LEACH-C all nodes sends the status message to the BS for each and every round. Thus the energy needed to send the status message to the BS is greater than the amount of energy needed to transmit the sensed data. To reduce the number of communication between nodes and BS, in [4] LEACH-CE (LEACH-Centralized Estimate) has been developed. Here the status message is received only for the 1st two rounds of the set-up phase. 3rd round onwards remaining energy level is calculated by the BS itself.

In [5] LEACH-CCB (LEACH Completely Controlled by Base-station) was developed based upon LEACH-CE. And also they have implemented sleeping concept. In LEACH-CCB SB receives the information and energy level of all nodes. Using this information 5% of nodes are selected as CHs. The base station makes 10% of the nodes in the network to go to sleep mode, which is done before the election of cluster heads. The nodes at sleep would not sense any data nor they receive cluster head information from the base station. BS controls all the operation of all nodes. LEACH-CCB maximizes the network lifetime, the number of useful messages received by the base station, and has a greater average energy in the network than LEACH-CE.

Many protocols have been developed to maintain energy in a network. But when we go for maintaining energy, throughput which is the main purpose of sensor network has been left out completely. Energy and throughput are tradeoffs. Thus now we are going to see how to increase the throughput of a network along with energy in consideration.

III. LEACH-CS (Low Energy Adaptive Clustering Hierarchy Centralized Sleeping Protocol)

LEACH-CS protocol is a modified version of LEACH-C protocol. Its functionality is same as that of LEACH-C. In addition to LEACH-C, ISM (Intelligent Sleeping Mechanism) a sleep scheduling concept is implemented.

First of all BS collects the information and energy level of all nodes and depending upon that results, it selects 5% of nodes in a network to be as CHs. Once the CHs are formed they broadcast their ID to other nodes. Nodes receiving these ID join the CH depending up on their signal strength. Thus clusters get formed. Then the CHs collect the data from their perspective cluster member, aggregate it and transmit the aggregated data to the BS. Here communication between nodes to CHs and CHs to BS is of 1-hop. Here the concept of ISM comes in to act.

ISM (Intelligent Sleeping Mechanism)

- CHs collect the data, aggregate it and send it to the BS.
- On receiving the aggregated data BS analyzes the first frame and compares with the threshold, which has been defined by the user.
- Then according to the threshold analysis, the cluster will be made either to be alive or switched to sleeping mode by the BS.

Thus the nodes, which are alive in that round aggregates the data and sends it to BS according to the TDMA slot assigned to it.

This process repeats for each and every round of the protocol operation.

IV. PROPOSED

CONCEPT *A.CLUSTER SETUP PHASE*

BS collects the information of all nodes. Threshold value is setup. Based on the threshold value the BS selects the cluster head. If same threshold value is existed for various nodes, then cluster head will be selected depending upon its priority as every node will have been given priority. After cluster head being selected, leaf nodes joins the cluster depending on the signal strength of the cluster head.

B.STEADY STATE PHASE

After the cluster along with its cluster head has been created, the CHs starts up its process. It collects the data from its members aggregate it and transmits it to the base station.

C.MODIFIED SLEEPING SCHEDULE

After the cluster head transmits the aggregated data to base station, BS compares the data's of CHs with the threshold we had defined.

- If it is above the threshold, then all nodes in that cluster be alive and compete in the current round.

- If it is below the threshold, then 2/3 of nodes in the cluster belonging to that cluster head will be made to sleep and 1/3 of nodes will be allowed to compete in that current round.

Thus this process repeats from the beginning for each and every round of the protocol operation.

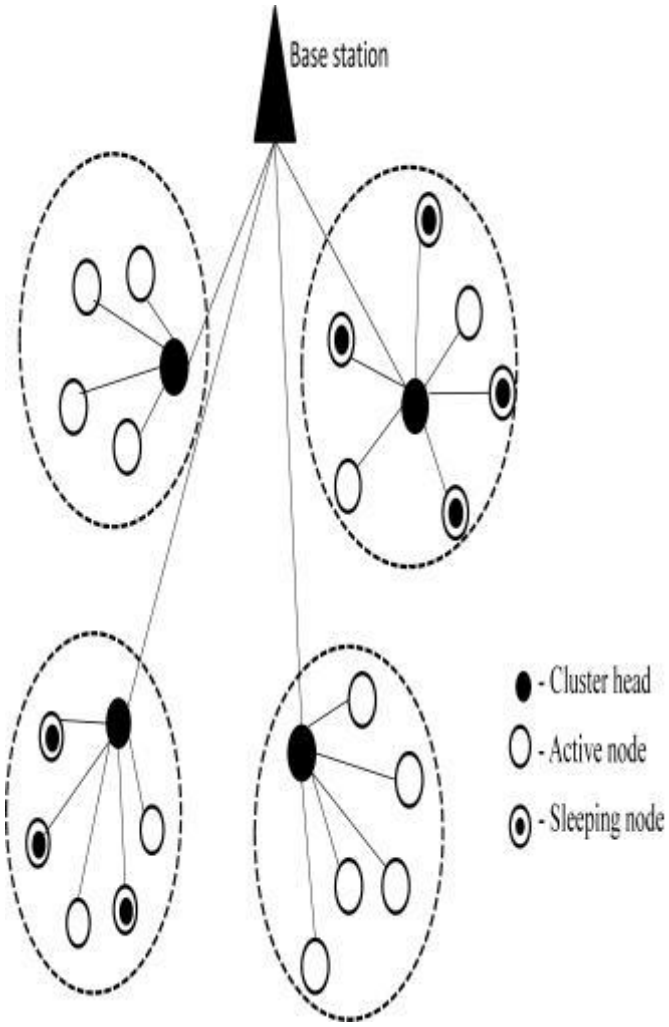

Fig.1. Modified LEACH-CS network

V. SIMULATION RESULTS

Fig.2 shows the throughput graph comparison of LEACH-CS with the modified idea. Thus the simulation result shows that the modified idea over the LEACH-CS concept produced a great improvement in the throughput of the network.

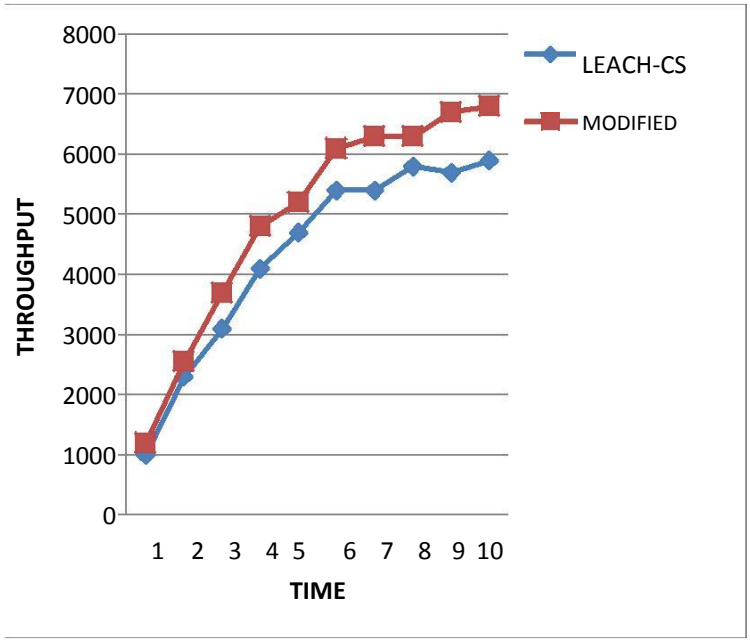

Fig. 2.Throughput of the network

VI. CONCLUSION

Thus in this paper our attempt towards the idea on modifying the sleeping mechanism of LEACH-CS showed to provide better result. Thus the throughput of sensor network got increased greatly. And we need not to worry much, when we look at the energy consumption of the network. Since we are making only 1/3 of nodes in the cluster to work, energy will not be consumed much when we look over with existing one.

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