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Data Aggregation using PEGASIS in WSN

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Abstract:

The technological advancement in wireless communication has paved way to the development of low-cost, low power and multifunctional sensor nodes. A wireless sensor network (WSN) is a network which includes sensor nodes which collects the sensed data and sends it to the sink. The nodes are battery driven and of low cost which has limited memory and computing power. The essential performance metric is to increase network lifetime and reduce the energy consumption as the replacement of energy is too expensive. Routing techniques are used to decide the transmission path in the network which is the main cause of energy consumption. The efficiency of wireless sensor network mainly depends on the routing protocol used. Hence, in the proposed work to increase the lifetime of the network and to reduce energy consumption PEGASIS (Power Efficient GAthering in Sensor Information System) protocol is used.

Keywords —WSN, Network Lifetime, Routing, PEGASIS.

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I. INTRODUCTION

   With the advancement in technology in the field of communication there is easy availability of electronic components which are connected via a wireless sensor network.

   Wireless sensor networks are used in a wide variety of applications for monitoring which includes environmental, health, military, home and industry automation. Routing is a method of transmission of data from source to destination node. It consists of sensor source nodes which includes sensing unit, power supply unit, ADC, Communication unit. The sensing unit senses the power of the entities such as temperature, pressure, light etc. The power supply unit manages the power in the node. The sensing unit transmits the received signal to ADC where it is converted into digital signal. The data signals can be transmitted to the other nodes or base station. The advantage of using these tiny devices to monitor the environment is that it does not require any infrastructure such as electric mains for power supply and wired lines for Internet connections for collection of data, nor need human interaction for deploying. If there is failure of the sensor nodes, the replacement of nodes are impractical due to mobility. In the cluster based sensor network data aggregation is done.
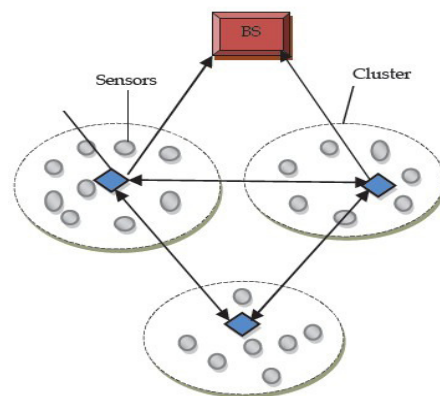

Fig. 1 Cluster based sensor network

In this the aggregation of data is done by giving higher priority to few nodes compared to others. In this process the nodes are divided into clusters and each cluster is assigned a cluster head where the cluster heads are responsible to transmit the data to the base station.
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II.PEGASIS

In the wireless sensor network the energy consuming process is that the transmission of data from node to the Base Station (BS).Hence a hierarchical architecture is implemented known as Power Efficient Gathering Sensors In System (PEGASIS) in which the entire network is divided into few clusters. Few of the nodes are elected as cluster head (CH) of each cluster to manage the tasks within the nodes. The process of clustering reduces the load on the network by utilizing the correlation among the data, aggregating them, which results in more efficiency.
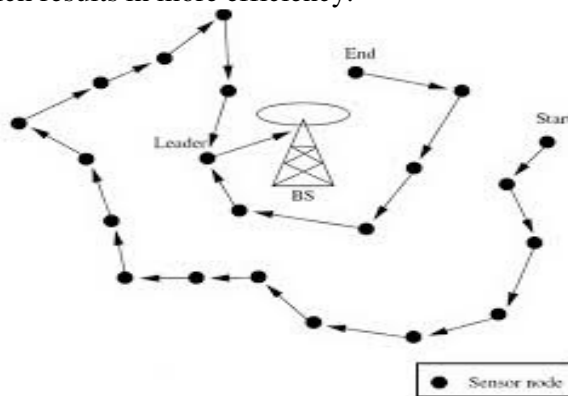

Fig.2 PEGASIS protocol

CHs are responsible for gathering the data from the sensor nodes, aggregating the data and finally transmit it to the BS.The objective of the hierarchical based routing protocols is to efficiently maintain the energy consumption of sensor nodes by involving them in multi-hop communication within a cluster and by performing data aggregation and fusion. It reduces the messages transmitted to the sink and transmission distance of sensor nodes. Each clustered WSN is said to have three main characteristics: cluster properties, CH properties and clustering process properties. The properties of cluster consist of size of cluster, number of clusters, intra-cluster and inter-cluster communication.

The CHs can be either stationary or mobile, network can be homogenous or heterogeneous and the elected CHs have substantial effect on the clustering algorithm performance. The algorithms used for clustering can be distributed or centralized and each of the algorithms has its own CH election mechanism.

For the reduction of energy the nodes form a chain in such a way that the data arrives through the shortest path which in turn reduces the total energy consumption. The structure of the chain will be modified to always maintain the minimum distance between the nodes.

III. RELATED WORKS

A number of data aggregation protocols have been proposed [1] in which it shows a multi-hop system, in which the devices use MAC protocol totransmit their uplink data to the BS. It results in loss of energy.

The idea behind the proposed systemin [3] is data aggregation at the base station is done by individual nodes which causes flooding of the data which consequences in maximum consumption of energy

The authors of [6] have only provided algorithms for building a two-level hierarchy, whichcan't be extendedto the protocols to develop multilevel hierarchies.

The protocols presented in [7] shows the detection of incorrect data by central nodes which is considered as one of the main advantages of this mechanism, but it has low fault tolerance and results in redundancy.

In the paper [8] Cooperative Multiple-Input-MultipleOutput (CMIMO) is a technique which is adopted in cluster-based WSN to bring in cooperation among the sensor nodes in a particular cluster. The cluster size is limited, so CMIMO is no more an energy efficient technique.

Their proposed algorithm [9] shows the nodes which meet for the threshold requirement are beneficial for the lifetime and communication quality of the network. As the number of the nodes used in a location is limited, the nodes which are frequently selected as the cluster heads would consume the energy quickly. Therefore, the appearance of first dead node in the proposed protocol is early when compared to other hierarchical routing protocol. Hence there is high chance of data loss and also power consumption is more.

IV.COMPARISON OF LEACH AND PAGASIS

In the proposed work two hierarchical protocols have been theoretically compared.

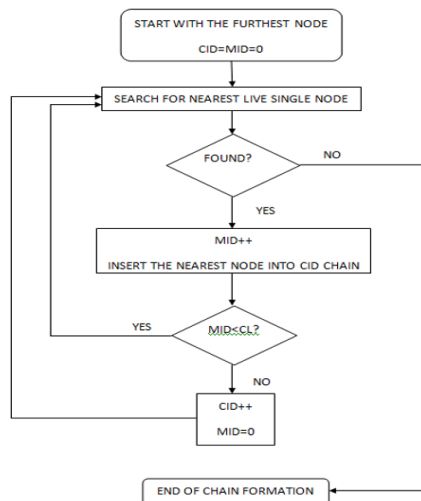| Parameter	LEACH	PEGASIS
Data delivery model	Cluster based	Chain based
Network lifetime	High	Very High
Power consumption	High	Low

V. METHODOLOGY

Fig.3Flowchart

From the Flowchart shown in Fig.3, Initially the process starts with the farthest node where the cluster ID (CID) and the Member ID (MID) equal to zero.

Search for the nearest live single node and if it's found then increment the member ID by 1 and insert it to the nearest node which forms a CID chain.

If there is no node nearby then no chain is formed else the MID is incremented until the size of the Cluster reaches maximum.

If the cluster maximum size is reached then the chain ends and the next node search for a single live node.

It starts forming the next chain and the Cluster ID is incremented and starts adding the member nodes.

The main advantage of this process is that, if there is any loss in a single node then the data in the node alone is lost. The other nodes reform the chain and transfer the data to the base station.
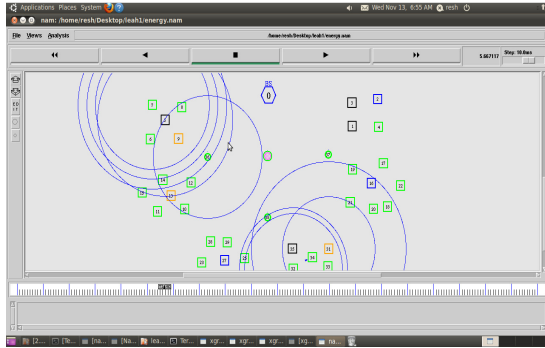
V. EXPERIMENTS AND RESULTS

In this work the simulation results of the node formation and transfer of information to the Base Station (BS) from nodes is shown using the software Network Simulator 2(NS2) tool.
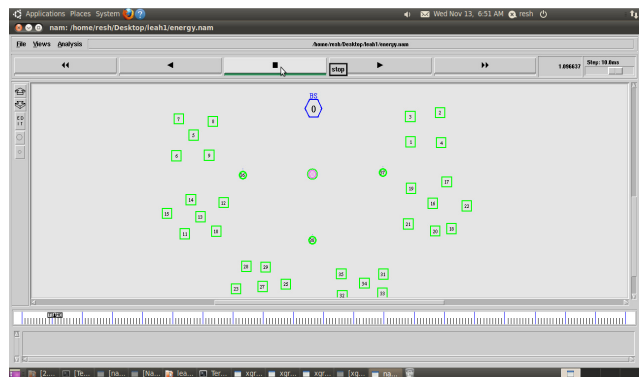
Node formation

The nearest live nodes are formed into a cluster to transmit the data from the Cluster Head which is nearest to the base station.

Collection of information from nodes by CH

The information which is collected by the nodes are made to form a chain and the aggregated data is transferred to the Head of the cluster through the node which is nearer to the base station.
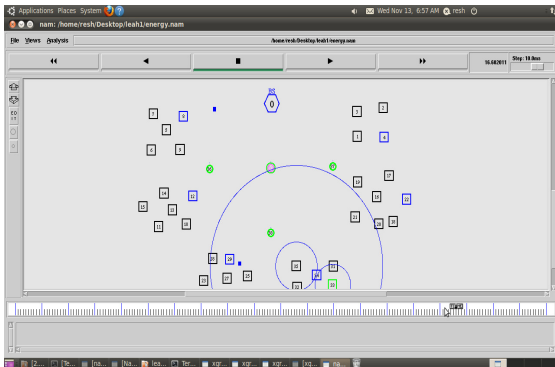
Aggregated data sent to Base station by CH

The data is collected from the nodes in the cluster, aggregated and sent to the Base Station.
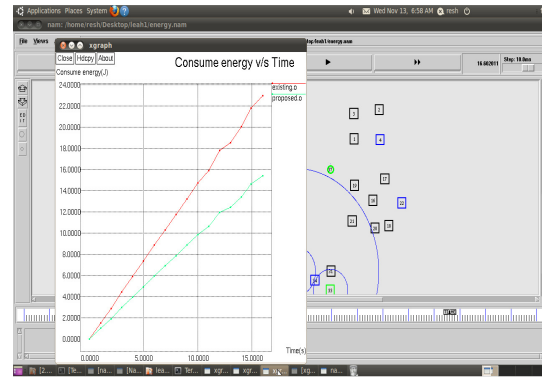

Fig. 4 Energy loss

The figure shows the energy consumed is less in the transmission of data from the nodes to the Base Station using the PEGASIS protocol than LEACH protocol.
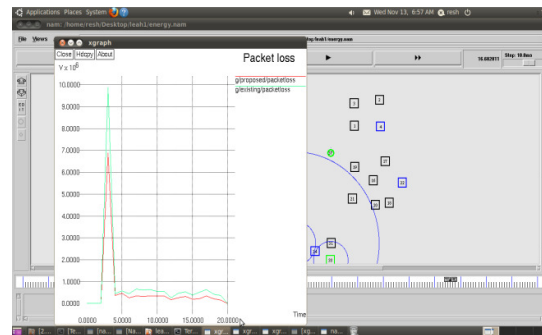

Fig. 5 Loss of packets

The figure shows the loss of packets in the proposed work is less as it forms a chain. As the data is aggregated in each node transfer even if there is loss in any node the data will be in the aggregator nodes.

V. CONCLUSION

Many solutions are provided to solve the issues in routing in Wireless Sensor Network which is the major issue. The proposed work shows that PEGASIS performs better when compared to other hierarchical routing protocols in terms of lifetime of the network, energy consumption and the number of node deaths. For the larger networks the

increases the stability as there is no early death of the sensor nodes. The Simulation results shows that the energy consumption is low and the loss of packets is less.

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