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Engery Efficient, Delay-Aware, Lifetime-Balancing Data Aggregation In WSN Using Clusters

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Abstract: ***A wireless sensor network (WSN) is a resource constraint network, in which all sensor nodes have limited resources. In order to save resources and energy, data must be aggregated. In order to save resources and energy, data must be aggregated, and avoid amounts of traffic in the network. The aim of data aggregation is that eliminates redundant data transmission and enhances the life time of energy in wireless sensor network. In this paper we have perform data aggregation using clusters, which should satisfy QOS parameters such as Energy Efficient, Delay-aware, Lifetime-balancing. We have used LEACH protocol and AODV routing protocol to find out optimal route which satisfy QOS.***

Keywords: WSN, Data Aggregation, Clusters, QOS, Energy Efficient, Delay-aware, Lifetime-balancing, LEACH, AODV.

I. INTRODUCTION

WSN consists of large number of nodes that is able to interact with physical parameter. The key advantage of using these small devices to monitor the environment is that it does not require infrastructure such as electric mains for power supply and wired lines for Internet connections to collect data, nor need human interaction while deploying. These sensor nodes can monitor the environment by collecting information from their surroundings, and work cooperatively to send the data to a base station, or sink, for analysis.

Data aggregation is the process of collecting and aggregating the useful data. Data aggregation is considered as one of the fundamental processing procedures for saving the energy. In WSN data aggregation is an effective way to save the limited resources. The main goal of data aggregation algorithms is to gather and aggregate data in an energy efficient manner so that network lifetime is enhanced. The main goal of data aggregation algorithms is to gather and aggregate data in an energy efficient manner so that network lifetime is enhanced.

There are various approaches of data aggregation some are as follows:

- ✓ Centralized Approach: In this approach only one sensor node play a role of aggregator node and all other sensor nodes are connected to that aggregator node. All other sensor nodes sense the data and transmit to the aggregator node which is called centralized node. There are so many loads on that aggregator node, so there is need of more energy and security on that aggregator node because all data is on the centralized aggregator node.
- ✓ Decentralized Approach: In this approach all sensor nodes performs aggregator function to the sensed data. In this approach there is no single centralized aggregator node but all nodes have same priority to aggregate the sensed data. In this approach all sensor nodes are connected to their neighbor node. This approach has the advantage of more scalability, dynamic changes node failure in the wireless sensor network.
- ✓ Network Aggregation Approach: In this approach one or more node can be aggregator node means sub aggregator node. This approach aggregates multiple data into single

data. It is important for improving the network lifetime and reduces the size of transmitted data on the network.

Clustering is a basic task grouping the data in data mining. It is usually used as a preparatory step in data mining for future data analysis. In this paper, LEACH clustering algorithm is proposed for the purpose of clustering sensors node in a wireless sensor network. The nodes within the clusters will forward the data to sink through cluster head where aggregation of data takes place.

II. RELATED WORK

Keerthana.S et al proposed an approach for Wireless sensor network consist of overhead problem which is also produced in the open vehicle routing protocol. To overcome this problem, energy efficient delay aware lifetime balancing data collection protocol is used. The EEDC protocol is used to reduce the total traffic cost for collecting data. Lifetime of the sensor nodes can be prolonged by avoiding traffic and delay during the transmission process. Both centralize algorithm and distributed algorithm operation are used.

Swetha et.al [2] they are conquered with many challenging problems and inferences such as energy utilization, network lifetime and delivery of data within time frame need to be addressed while performing routing techniques, the tiny sensor nodes are battery operated and randomly deployed in harsh environment. To achieves the entire core challenges of the network operations. A new Energy-Efficient Delay–Aware Lifetime-Balancing (EDAL) protocol facilitates the reliable routing scheme for WSNs using centralized and distributed heuristic based on the tabu search and ant colony status gossiping routing techniques. An extensive simulation studies to rigorously evaluate the performance of proposed algorithms C-EDAL and D-EDAL using MATLAB. The simulation results shows that the heuristic approach reduces its computational overhead, scalability and efficient for large scale networks.

Merina Devi Hemam et.al [3] the technique that is used in this paper is to make it simpler for wireless sensor networks problem. To make the energy more efficient a protocol is used that is called EDAL. It is rebuilt from the existing system called OVR which uses NP-hard algorithm. To make more prominent a centralized heuristic is design to make the computational overhead smaller and to detect the dead nodes. As it has some limitation distributed heuristic is design which is the best for large scale networks.

III. PROPOSED SYSTEM

Figure1 Shows the Architecture of our proposed system. It includes following modules:

A. NETWORK INITIALIZATION

Network initialization is to specify various network parameters before actually starting a network. The parameters include the working channel, the network identifier, and network address allocation.

B. CLUSTER FORMATION

Cluster is formed using Low Energy Adaptive Clustering Hierarchy Aggregation (LEACH).

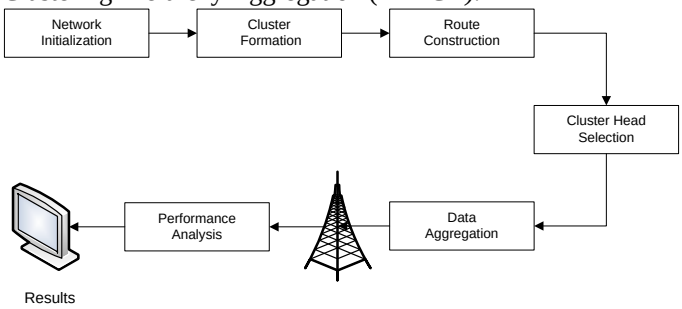


Figure 1: Proposed Architecture

The LEACH protocol is distributed and sensor nodes organize themselves into clusters for data fusion. A node is designated as the cluster head in each cluster, transmitting the data received from the sensors in its cluster to the sink. The probability is given by

$$P_{CH} = C * \frac{E_{residual}}{E_{max}} \qquad (1)$$

Where C denotes the initial percentage of cluster. Residual is the estimated current residual energy of the node. E_{max} is its initial energy corresponding to a fully charged battery.

LEACH protocol works in rounds. Each round is divided into two phases: Setup phase and Steady phase

In Setup phase, at the beginning of the round, each node decides independently of other nodes whether or not to become a cluster head for current round. Each sensor node generates a random number such that 0< random < 1 and compares it to a pre-defined threshold T (n). If random < T (n), the sensor node becomes cluster-head in that round, otherwise it is cluster member. The threshold is given T (n) below: (IPP) and retrieve the results. The work can be explained in stepwise as below:

$$T_{(n)} = \frac{p}{1 - p(rmod\left(\frac{1}{p}\right))} \qquad (2)$$

Where, P is the probability of the node being selected as a cluster-head node. r is the number of rounds of selection. G is nodes that are cluster heads in round r shall not be selected in the set of nodes that haven't been cluster-heads in the last 1/P rounds mod denotes modulo operator. the next 1/P rounds. After CH selection, the CH will broadcast an advertisement message using CSMA MAC protocol to its neighbors that it is the new cluster-head. Each CH knows its own cluster members information. The CH node sets up a TDMA schedule for data transmission coordination within cluster and broadcast it to its cluster members. The TDMA schedule prevents collision among data messages and conserves energy among non-cluster head nodes. So all the member nodes know their TDMA slots, and then the steady-state phase begins.

In the steady-state phase, cluster members sense the surroundings and transmit the sensed data to their CH depending on the TDMA schedule received at the setup phase. SNs go into sleep mode to save energy for other slots. When the CH receives all the data sent by its cluster members, it will aggregate them and then send the aggregated data to BS. After

a certain time, the network goes back into the setup phase again and enters another round of selecting new CH.

C. ROUTE CONSTRUCTION

Route construction using Ad hoc On-demand Distance Vector Routing (AODV) AODV is an on-demand protocol, which initiate route request only when needed. When a source node needs a route to certain destination, it broadcasts a route request packet (RREQ) to its neighbors. Each receiving neighbor checks its routing table to see if it has a route to the destination. If it doesn't have a route to this destination, it will re-broadcast the RREQ packet and let it propagate to other neighbors. If the receiving node is the destination or has the route to the destination, a route reply (RREP) packet will be sent back to the source node. Routing entries for the destination node are created in each intermediate node on the way RREP packet propagates back.

D. CLUSTER HEAD SELECTION

From among the sensor nodes which are at the first level of distance and the next level of distance from the centroid, we take the nodes with the highest energy and select the one which is the nearest as the CH. Using Euclidean distance defined by

$$Dist(X_1, X_2) = \sqrt{\sum_{i=1}^{n} X_{1i} - X_{2i}} \quad (3)$$

Where X_1 *and* $, X_2$ are two different nodes.

E. DATA AGGREGATION

Data aggregation aims to reduce power consumption. It combines and summarizes the data packets of several nodes so that amount of data transmission is reduced. Here we gather the data packets from different CH.

IV. RESULTS

In this section explains the output of our proposed system. We are finding output using NS2 tool for analyzing our proposed system. In this section we have computed performance analysis using different parameters:

- ✓ *ENERGY:* The Energy of the route is used find out the total energy consumed over the entire route. The Energy Consumption between two nodes is given by

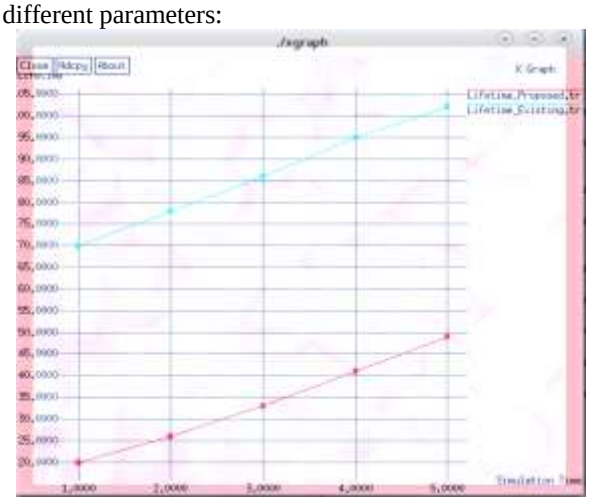
$$E_c = 2E_{TX} + E_{gen}\, d^{\gamma} \quad (4)$$

- ✓ *DELAY:* The average time taken by a data packet to arrive in the destination. It also includes the delay caused by route discovery process and data packet transmission. Only the data packets that successfully delivered to destinations that counted. The lower value of end to end delay means the better performance of the protocol. Result 2 describes end-to-end delay our proposed system. It is calculated using:

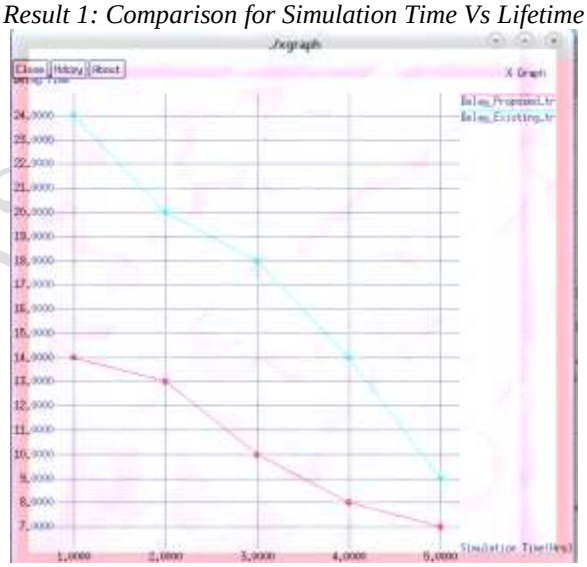
$$\sum(arrive\ time - send\ time) / \sum Number\ of\ connections. \quad (5)$$

- ✓ *NETWORK LIFETIME:* Network Lifetime is a time duration at which the first dead node occurs in the network.

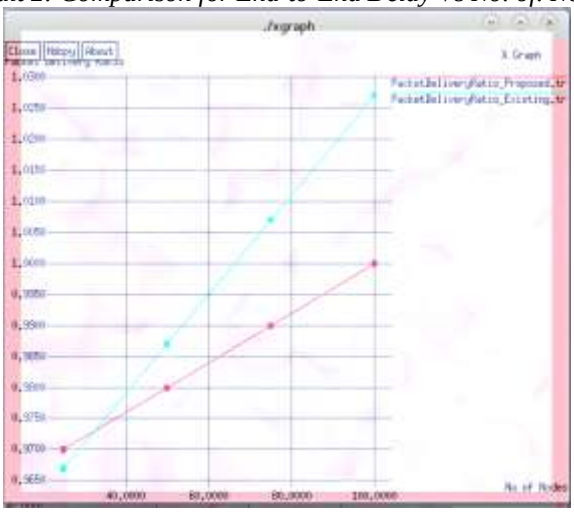
Below Graphs shows the results of performance analysis for different parameters:



Result 1: Comparison for Simulation Time Vs Lifetime



Result 2: Comparison for End-to-End Delay Vs No. of. Nodes



Result 3: Comparison for No of Nodes Vs Packet Delivery Ratio

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V. CONCLUSION

In this paper we have developed cluster based Data aggregation in WSN. Main aim is to obtain some QOS parameters and to generate routes that connect all source nodes with minimal total path cost, under the constraints of energy efficiency, packet delay and lifetime balancing requirement. Use of LEACH as recorded good results in increasing network lifetime.

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