Abstract:- In today’s scenario, the energy conservation is the main paradigm for prolonging the network lifetime. In the wireless sensor network, the cluster head selection is the main issue, which can enhance the whole network lifetime and improve their scalability. Here, the cluster head selection is done by using the three parameters, i.e. node degree, average energy and minimum path loss factor. A new inter cluster data aggregation technique with LZW reliant compression is applied which provides greater functionality in the homogeneous and heterogeneous WSNs.

Keywords: Wireless sensor network, network lifetime, node degree, average energy, minimum path loss factor.

I. WIRELESS SENSOR NETWORK

Wireless sensor network is a wide research topic having its applications in military, battlefield monitoring, industry and environmental monitoring. In the wireless sensor network, the sensor nodes are deployed uniformly or randomly to collect the data from the environment and send it to the sink. In the WSN, the new routing protocols have been designed which improves the energy awareness[1,2]. At the network layer, the main issue is with route setup and reliable relaying of the data from nodes to the sink so that the network lifetime can be maximized. In wireless sensor network, the routing protocol finds the route for packet delivery and sent it to the correct destination. Routing is the main issue in the wireless sensor network. Firstly, it is not possible that the nodes should be deployed by using global addressing scheme. The IP based protocols cannot be used in the sensor networks. Secondly, the sensor networks requires the flow of data from multiple sources to the sink. Thirdly, the factor is redundancy, where multiple sensor nodes generate the same data. Such type of redundancy can be removed by using several routing protocols which enhance the energy as well as bandwidth utilization. Fourthly, the constraints of sensor nodes are transmission power, on-board energy, processing capacity and storage. Due to these differences, many protocols have been developed. These routing techniques have the characteristics of sensor nodes along applications and architecture requirements. The protocols can be distinguish on the basis of data-centric, hierarchical and location based networks. Very few papers have considered the QoS[5,6] measure along with routing functions.
II. HETEROGENEOUS ROUTING PROTOCOLS

A. DEEC (Distributed Energy-Efficient Clustering)

DEEC (Distributed Energy-Efficient Clustering):- In DEEC protocol[3], all nodes use the initial and the residual energy level to define the CH’s. DEEC estimate the ideal value of network lifetime to compute the reference energy that each node should expend during the each round. In a two-level heterogeneous network, where we have two categories of nodes, m. N advanced nodes with initial energy equal to Eo. (1+a) and (1 − m). N normal nodes, where the initial energy is equal to Eo. Where a and m are the two variable which control the nodes percentage types which is (advanced or normal) and the total initial energy in the network of $E_{total}$. The value of Total Energy is given as

$$E_{total} = N \times (1-m) \times Eo + N \times m \times Eo \times (1+a)$$

- Energy of rth round is set as follows

$$E(r) = \frac{1}{N} E_{total}(1-R)$$

Where R denotes total rounds of network lifetime

$$R = \frac{E_{total}}{E_{round}}$$

The possibilities of regular, improve as well as super nodes are often shown by means of formula

$$P = \begin{cases} 
\frac{P_{opt} E_i(r)}{(1+am)E(r)} & \text{for normal nodes, } E_i(r) > TH \\
\frac{(1+a)P_{opt} E_i(r)}{(1+am)E(r)} & \text{for advanced nodes, } E_i(r) > TH \\
\frac{c(1+a)P_{opt} E_i(r)}{(1+am)E(r)} & \text{for adv, nml nodes, } E_i(r) \leq TH 
\end{cases}$$

The simulation effect discloses that DEEC have the longer life time and also additional productive efficient messages comparing with other methodologies[7,8].

B. DDEEC (Developed Distributed Energy-Efficient Clustering)

DDEEC protocol id developed by brahimelbhiri et al. basically, this protocol is used for energy efficiency[4]. This protocol is based on residual energy for cluster head selection for balancing the whole network. DDEEC used the same formula for the estimation of average energy in the network and also the selection of cluster head based on the residual energy as expressed in DEEC. The basic difference between DEEC and DDEEC is in expression that defines the probability for normal and advance nodes to be a cluster head. The advance nodes have the higher energy and normal nodes have the lower energy. So that’s why advanced nodes are used for the selection of CH as compared to normal nodes. The DEEC protocol have the advance nodes which act as a CH continuously and die more quickly than normal nodes. For avoiding such type of problem, the DDEEC introduces the threshold residual energy. The formula is given below:-

$$TH = E_o \left(1 + \frac{\frac{aE_{dis\ NN}}{E_{dis\ NN} + E_{dis\ AN}}}{E_{dis\ NN} + E_{dis\ AN}}\right)$$

For the selection of CH the DDEEC uses the following equations
C. BEENISH Protocol

BEENISH (Balanced Energy Efficient Network Integrated Super Heterogenous Protocol for Wireless Sensor Networks) protocol [1] have the same concept of DEEC while choosing the cluster head selection, which is totally based on residual energy level of nodes with respect to average energy of network. As we studied, DEEC is based on two types of nodes that are normal and advance nodes but the BEENISH protocol uses the four types of nodes that are normal, advanced, super and ultra-super nodes. In BEENISH, the ultra-super nodes are used as cluster head as compare to super, advance nodes and normal nodes. So that the energy consumed by all nodes should be equally distributed. In BEENISH, the four level heterogeneous network in which normal, advance, super and ultra-super nodes are used. The probability for four types of nodes are given below.

\[
P_t = \begin{cases} 
\frac{P_{opt} E_t(r)}{[1+(m+a+b+1)(-b+u)]E_t(r)} & \text{for normal nodes} \\
\frac{P_{opt}(1+a)bE_t(r)}{[1+(m+a+b+1)(-b+u)]E_t(r)} & \text{for advanced nodes} \\
\frac{P_{opt}(1+b)E_t(r)}{[1+(m+a+b+1)(-b+u)]E_t(r)} & \text{for super nodes} \\
\frac{P_{opt}(1+b+1)E_t(r)}{[1+(m+a+b+1)(-b+u)]E_t(r)} & \text{for ultra super nodes} 
\end{cases}
\]

BEENISH is the most efficient protocol in terms of network lifetime, stability period and throughput. In BEENISH the basic concept of cluster head is based on residual and average energy of the network. So, in this way the different heterogeneous protocols are defined with the selection of cluster head based upon different parameters. The tabular form of different heterogeneous protocols is defined in terms of table.

<table>
<thead>
<tr>
<th>Clustering Approach</th>
<th>Heterogeneity Level</th>
<th>Initial Energy</th>
<th>Average Initial Energy</th>
<th>Residual Energy</th>
<th>Avg. Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEEC</td>
<td>Two/Multi</td>
<td>-</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>DDEEC</td>
<td>Two</td>
<td>Yes</td>
<td>-</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>BEENISH</td>
<td>Four</td>
<td>-</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

III. QoS STRATEGY

In the qos approach, the cluster head selection is based upon three factors. They are node degree, average energy and the minimum path loss factor[6]. The following factors are considered during the cluster head selection. Firstly, calculate the neighbors of each node in the network. The nodes must be in its transmission range. The distance should be calculate using the Euclidean distance formula.

\[
distance = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}
\]

In the node degree, the maximum node degree is having total number of neighbors. For each node, calculate the sum of distances with all of its neighbors[9,10]. Distance between nodes calculated via Euclidean distance which help in determining the total loss. The average energy of each node can be calculated as

\[
E_{AVG} = \frac{1}{N} \sum_{v \in N_v} E_v
\]

Where, \( E_v \) is the residual energy of all the neighbor nodes. The position factor POS is calculated using following equation

\[
POS_v = \alpha N_v + \beta E_{AVG} + \mu (1/P_v)
\]

Where, \( \alpha + \beta + \mu = 1 \)
\( \alpha \), \( \beta \) and \( \mu \) are the weighting factor for the given parameters. Always choose the highest POS as the cluster head.

IV. SIMULATION RESULT

In this simulation environment, the 100 sensor nodes are deployed in the area of (100,100). The MATLAB simulator is used for the given experiment. The parameters are listed below in the given table. The metrics used for the simulation are:

- Remaining Energy
- Packet send to base station
- Packet send to cluster head
- Dead nodes
Table 2: Simulation Parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (x, y)</td>
<td>100,100</td>
</tr>
<tr>
<td>Base Station (x, y)</td>
<td>50,50</td>
</tr>
<tr>
<td>Number of nodes</td>
<td>100</td>
</tr>
<tr>
<td>Probability</td>
<td>0.1</td>
</tr>
<tr>
<td>Initial Energy</td>
<td>0.5J</td>
</tr>
<tr>
<td>Transmitter Energy</td>
<td>50 nJ/bit</td>
</tr>
<tr>
<td>Receiver Energy</td>
<td>50 nJ/bit</td>
</tr>
<tr>
<td>Free space Energy</td>
<td>1.0 nJ/bit/m^2</td>
</tr>
<tr>
<td>Multipath Energy</td>
<td>0.0013 nJ/bit/m^2</td>
</tr>
<tr>
<td>a</td>
<td>3</td>
</tr>
<tr>
<td>b</td>
<td>2</td>
</tr>
<tr>
<td>Number of rounds</td>
<td>10,000</td>
</tr>
<tr>
<td>Message Size</td>
<td>4000 bits</td>
</tr>
</tbody>
</table>

V. SIMULATION SCENARIO

A. BEENISH

This is the environment of BEENISH protocol, where area is 100*100 meter. Here, the environment of simulation is at the end, where all the Red triangle nodes are dead and center one is the base station.

Fig 2. Simulation Environment of BEENISH protocol

B. Remaining Energy

This is the graph of Beenish protocol remaining energy, which shows how much energy is left after the simulation. X axis shows the number of rounds. Here we have implemented the 10,000 rounds. The energy ends at the round of 8500.

Fig 3. Remaining energy Vs Rounds

C. Packet to Base station

This is the graph of Packet send to base station in Beenish protocol, which shows the total number of packets send to the base station by the sensor nodes. X axis shows the number of rounds. Here we have implemented the 10,000 rounds. The packets send to base station is near about 2.4*10^5.

Fig 4. Packets send to base station Vs Rounds

D. Packet to Cluster Head

This is the graph of Packet send to cluster head in Seenish protocol, which shows the total number of packets send to the cluster head by the sensor nodes.
At the round of 10,000, the total number of packets are $5 \times 10^4$.

Fig 5. Packets send to CH Vs Rounds

E. Dead Nodes
This is the graph of dead nodes in Beenish protocol. The network lifetime can be evaluated by using the number of dead nodes. It has been found that the number of nodes die earlier in Beenish protocol. Here, we can see from the graph that the nodes are die at the round of 1500.

Fig 6. Dead nodes Vs Rounds

VI. QOS BASED BEENISH PROTOCOL
A. QoS BEENISH
This is the environment of QoS BEENISH protocol, where area is 100*100 meter. Here, the mid environment of simulation is run. where all the Red triangle nodes are dead and center one is the base station and the red lines shows the communication between nodes.

Fig 7. Simulation Environment of QoS BEENISH protocol

B. Remaining Energy
This is the graph of Beenish protocol remaining energy, which shows how much energy is left after the simulation. X axis shows the number of rounds. Here we have implemented the 10,000 rounds. The energy ends at the round of 10,000.

Fig 8. Remaining energy Vs Rounds

C. Packet to Base station
This is the graph of Packet send to base station in Beenish protocol, which shows the total number of packets send to the base station by the sensor nodes. X axis shows the number of rounds. Here we have implemented the 10,000 rounds. The packets send to base station is near about $1.9 \times 10^5$
Fig 9. Packets send to base station Vs Rounds

Fig 10. Packets send to CH Vs Rounds

D. Packet to Cluster Head

This is the graph of Packet send to cluster head in Beenish protocol, which shows the total number of packets send to the cluster head by the sensor nodes. At the round of 10,000, the total number of packets are $8.5 \times 10^5$.

Fig 11. Dead nodes Vs Rounds

E. Dead Nodes

This is the graph of dead nodes in Beenish protocol. The network lifetime can be evaluated by using the number of dead nodes. It has been found that the number of nodes die earlier in Beenish protocol. Here, we can see from the graph that the nodes are die after the round of 4000 which shows the network lifetime is more.

VII. CONCLUSION

In this paper, we have proposed the QoS based BEENISH Protocol, which is an improved energy efficient beenish protocol. This protocol adopts the selection of cluster head using node degree, average energy and minimum path loss factor, which outperforms BEENISH. The proposed protocol shows the better improvement over existing protocol as the network lifetime is more in the QoS BEENISH protocol. In future work, we can implement some other optimization technique on cluster head selection and also work on WSN 3D environment.

VIII. REFERENCES


