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SIMULATION OF ENERGY EFFICIENT COMMUNICATION OVERHEAD ALGORITHM IN WIRELESS SENSOR NETWORKS USING NS-2

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Abstract - Energy efficiency in wireless sensor network has gained important. Energy efficient routing algorithms are proposed to increase the lifetime of the network. Routing energy is consumed in topology assessesments where the sink broadcast the message and after receiving the acknowledgement assesses the current topology of the network. Our work studies the topological behavior of WSN and proposed an algorithm which can maximize the lifetime by reducing communication overheads increase due to topology assessments.

Introduction

A wireless sensor network is collection of small sized large number of wireless sensor nodes .Sensor node small are in size,with low power and multifunctional, devices having sensing, data processing, and communicating components .In Wireless sensor network number of nodes are fixed it depend on the application where they are used and also in the area which they monitor. The primary task of the wireless sensor node to sense the environment and gather data and sent it to the base station. A wireless network consists of tiny devices which monitor physical or environmental conditions such as temperature, pressure, motion or pollutants etc. at different areas. Wireless sensor network has important role in vast variety of environments for commercial, civil, and military applications such as surveillance, vehicle tracking, climate, home application, hybrid networks and habitat monitoring, intelligence, medical, and acoustic data gathering. Fig 1dipicts the routing of sensor nodes with sensor field.

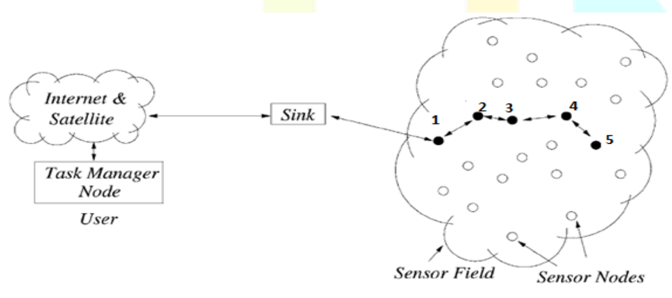

Fig 1 Sensor nodes in sensor field

The WSN work in three phases that are given below:

In 1st phase (Registration phase): The sink node send a control packet to it neighbor node and when the neighbor get that control packet it send acknowledge back to sink node and registration with the sink is done

In 2nd phase (data transmission): In this phase sink communicate with registered sensor node .The sink gets the data from the registered sensor node. All the routing algorithm are design for the second phase of data transmission

In 3rd phases (Check connectivity): In this phase the sink sends control packets to register neighbor node to check it connectivity and it send it again and again to maintain and check the connectivity.

Characteristics of wireless sensor network: Wireless sensor network has several features [4] such as mobility, switching characteristics and the limit capability of the battery power. Comparing to these wireless networks, WSN also has some distinctive properties. The characteristics of WSN are as follows [5]:

- **Computing capabilities:** Due to the limit of cost, size and battery power consumption [3], program space and memory space of the sensor is very limited.
- **Battery energy:** Sensor nodes often become invalid and abandoned because the power is exhaust. The life of sensor node depends upon the battery energy. The energy consumption of the nodes transmit data information is more than the energy of the nodes.
- **Communication capabilities:** Senor Network includes communication bandwidth is narrow and changeable, and its radio frequency distance is only tens to several hundred meters. However the senor is easily influenced by the impact of natural environment such as mountains, buildings and storms, rains and lighting, the terrain obstacles and the weather.
- **Dynamic:** The sensor node exits from the networks because of the battery exhaustion and other failures. It is also possible that some new sensor nodes can be moved into network according to the task. These will bring about changes in the topology of network, so the WSN topology must have the function of the reconfiguration, and self-adjustment. It imposes difficulties in the research area.
- **No centre, self-organization: The** deployment of wireless sensor nodes does not need pre installation of any network infrastructure.
- **Multi-hop communications:** Sensor node can communicate with direct neighbours in the WSN [9] . If one node require to communicate with other nodes, which are beyond the coverage of the node's radio frequency than it can be done via multi hop route transition data through the intermediate nodes.

Related Work: Power plays an important role in Wireless Sensor Network. Reducing power and extending the life time of network is an important issue in WSN. There is different way to achieve this. Power awareness routing protocol select suitable transmission range and routes to conserve power. Energy can preserve for multichip packet transmission.

Sleep management, the radios which are not in use and are an ideal state can be turned off, and hence the amount of total energy wasted can be reduced.

Topology control, ensuring conservation of energy, network properties, over all transmission power is reduced by the amendment of transmission range at each node.

Lin WANG, Weiliang ZHAO, [2] has been proposed a topology control algorithm for wireless sensor network and to save node's power and protract the lifetime of the network. today, there are two traditions for wireless sensor networks to keep power: hierarchical. Topology control and power control. In this paper, they recommend a new topology control technique Sleep-supported and Cone-based Topology Control method (SCTC), which integrates episodic sleep and topology control. The simulation outcome explain that SCTC can keep power utilization and expand the duration of the network .

Seungki Hong, Yeon-Jun Choi [3] gave energy efficient topology control protocol in Wireless sensor network. Topology Control is the techniques in wireless sensor networks to reduce energy expenditure. In this paper, they suggest the topology control protocol which doesn't use the position information of nodes and depend on the radio propagation model like earlier works by proving actual transmission energy between sensor nodes to be feasible in real applications. They also consider the probable difficulty in topology control design which can be occur in the case where network traffic is converged on specified node due to transmission energy control.

Guoliang Xing, Chenyang Lu and Robert Pless[4] They proposed a new topology control conceptualization for lossy wireless sensor networks that captures the stochastic character of lossy links and quantify the worst-case path quality in a network .They suggested a novel localized method called Configurable Topology Control (CTC) and do the simulations by using a realistic radio model of Mica2 motes show that CTC extensively outperforms a representative traditional topology control algorithm called LMST in terms of both communication performance and energy efficiency.

Shuai Gao, Hongke Zhang, Tianfei[5] Gao proposed an most advantageous task of sensor nodes and routing solution, that maximize the network lifetime by maximizing the network throughput. By doing the simulation on OMNET++ they proved that their proposed scheme outperforms SPT and MASP in terms of total amount of data and network lifetime correspondingly.

Amulya Ratna Swain described [6] in the wireless sensor network, random and synchronized are two major approaches to sleep scheduling of sensor nodes. They proposed an approach that reduces average energy consumption rate of each node as they put more number of nodes to sleep in contrast to other approaches.

Thaskani and Murthy[7] they considered wireless sensor networks in which users are able to control the topology. Depending on this category there are several applications. They suggested a novel levelling and clustering algorithm in such networks. They carried out the performance by comparing the algorithm with earlier protocols. It is realized that the algorithm can also be used for localization

Algorithms only cates to and does not concentrate the above the phase 2 and does not concentrate on the energy overheads in phase 3 .The energy consumption of control packet can be reduced by developing algorithm to understand the behaviour of network. The energy consumption [12] can be reduced by reducing the continuous flow of control packet for topology assessment are warn is issued on energy reduction in phase 3

System Model:

Consumption of power takes place in various processes in a sensor node, some of them being-sensing, data communication and processing of local data. It has to be made sure by the wireless sensor network that they conserve energy so as to operate for long periods without power sources which are wired. To be sure of longevity of WSN the sensor devices need energy aware design power conserved by routing and can be efficiently conserved by routing nodes properly and scheduling algorithm. We find a lot of problem in topology control nature of Wireless Sensor Network. In the Wireless Sensor Network all node decay its energy and on behalf of that we have its time of living some node die earlier and some take more time for die out and time of dyeing depend upon how much power sensor node have more power more living time.

In the 3rd phase the sink node send control packet to sensor node, to check the connectivity of sensor node. In traditionally sink send this control packet (CP) repeatedly after a particular time period so that most of it energy it is waste to check the connectivity.

Proposed Algorithm: There are n nodes in the network. Since lots of energy is dissipated in sending control packets and receiving acknowledgement we proposed an algorithm to reduce the energy loss. We have assumed communication energy dissipation overhead as 'O' for several nodes .The communication overheads of all the nodes are same and the nodes are similar. All the sensor nodes communicate with sink only. The sink node has maximum energy 'Es whereby the sensor nodes have variable energy (E1, E2, E3……En). Sink node sends control packet to the nodes to check the connectivity and thus determine the topology. Once a sensor node dies at the topology is reconfigured. The sensor node and acknowledgement to the sink node whereas control packets are send and give their connectivity status. If no acknowledgement is received by the sink node then it assumes that the node has died out. Sink nodes consumed energy Et transmitting the control packet E_A in receiving acknowledgement whereas sensor node consume energy E_R in receiving control packets and E_{At} in sending acknowledgement given by Eq1 and 2

$$Es=Es-Et-E_A*n-O \quad \text{……………….(1)}$$

$$En=E_{At}-E_R-O \quad \text{…………………..(2)}$$

Since sink node receives n acknowledgement, it will require E_A*n energy for receiving total acknowledgements as the no. of nodes die the value of n decrease and energy consumption [38] in receiving acknowledgement also decreases .Sink node computes the probabilistic time in which the node will reach the threshold energy limits minimum time 't' is considered as the wait time. Wait time is the time for which the sink node holds the process of sending the control packets for topology configuration. After the time t has expired again sends the control packet to checks whether the sensor node with minimum energy has come to the threshold level or not. If it is in range of threshold it deregisters the node. If the node is not in the threshold range then it again computes minimum energy node die out time 't'. Here the energy is sending and receiving the packet for sensor node and the sink node is saved for topology configuration. The algorithm 1 and 2 are compared to find the % energy saved and increase in life time of system.

Algorithm 1

1. Set the energy threshold value for sensor node.
2. Initial Energy of the sensor node (E1, E2………En) and the initial energy of sink node Es
   and O is the communication overhead energy.
3 Sink send control packet often every 10 second till the energy of all node become zero
4. Calculate Es, En for the Equ.1and Equ.2
5. Display time for sending control packet and energy for each node and sink node

6. Also calculate total energy consumption of sink node.
7. Go to step 3
8. Exit

Algorithm 2

1. Set the energy threshold value for sensor node.
2. Initial Energy of the sensor node(E1, E2………En) and the initial energy of sink node Es
 and O is the communication overhead energy.
3 Sink send control packet to the sensor node
4. Calculate Es, En for the Equ.1and Equ.2
5. Check threshold for each node and below this node consider to be die out
6. Calculate probabilistic time for die out each sensor node; find out min time of Et
 T=En/O // for this min time sink node do not send control packet
7 Now calculate Es=Es-O
 En=En-O
8. Go to step 3
9. Exit

Numerical analysis and Simulation in NS-2.34: Here we are taking 10 sensor nodes and 1 sink node and in first algorithm we assume that the sink node sends per second control packet to check the connectivity of neighbour nodes and each neighbour node after receiving the control packet send back acknowledgement. The sink node again repeats the same process. In second algorithms the sink send at t=0 send the control packet to neighbour nodes and neighbour nodes after receiving this control packet send back the acknowledgement along with the energy status and sink node with the help of this energy status find out the probabilistic time when the node die out and then it find out the minimum time and sink node go to the sleep mode for this minimum time. The algorithm in develop in C++ and NS2.34 and analysis the results we got the following results.

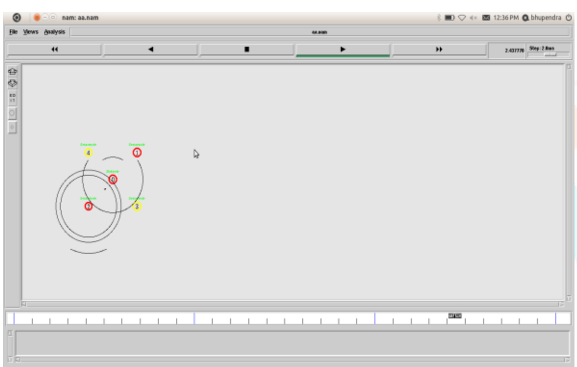

Figure 6:Scenario of WSN Algorithm 1

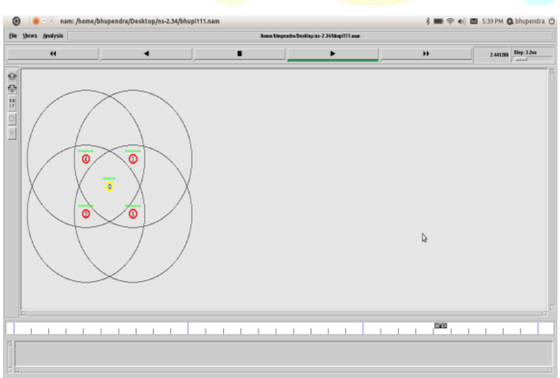

Figure 7: Scenario of WSN Algorithm 2

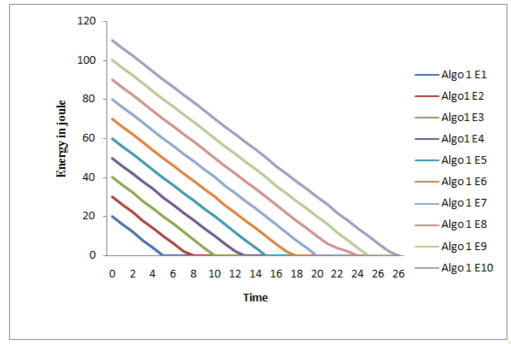

Figure 8: Energy of Sensor Node by Algo1

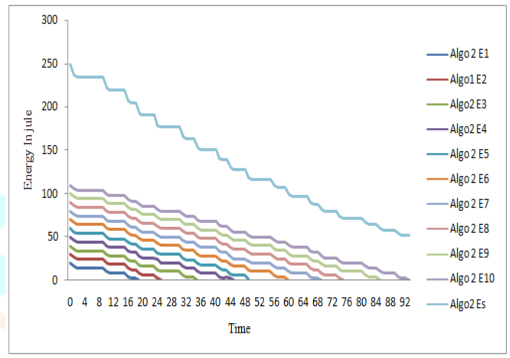

Figure 9: Energy of Sensor Node by Algo2

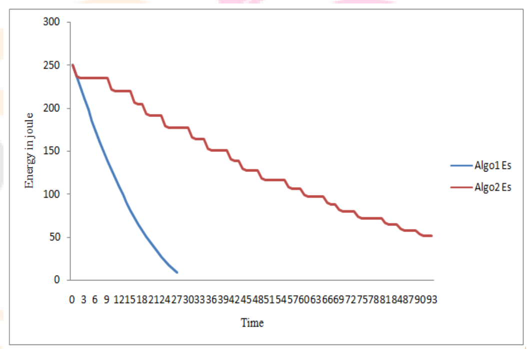

Figure 10: Energy of Sink Node in Algo1and Algo2

From the figure 8, 9, and 10 we have got to knew that propose algorithms considerably improve the life time of the WSN.
Node 1 life time increase by 3.5 times
Node 2 life time increase by 1.7 times
Node 3 life time increase by 2.08 times
Node 4 life time increase by 2.13 times
Node 5 life time increase by 2.05 times
Node 6 life time increase by 2.1 times
Node 7 life time increase by 2.22 times
Node 8 life time increase by 1.96 times
Node 9 life time increase by 2.22 times
Node 10 life time increase by 2.13 times

Conclusion: Power consumption plays an important role in Wireless Sensor Network. One can save the power by using the different mechanism like power aware routing protocol, topology control, sleep management and also some hardware changes. Topology control helps to save power, in that one can deploy the node and use the power of sensor node in a way so that we minimize the wastage of energy. In topology management state change (sleep, listen , active) also are important aspect in saving energy.

From the result we came to know that the energy saving in the 2nd algorithm is more as compare to algorithm 1st algorithm and is numeric value is equal to 20.09%.

Future work: In future the above algorithm can be simulate in NS 2

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