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An Efficient Organization for Wireless Sensor Networks

Madhuneha A. Shrivastava[1], Prof. R.K. Krishna[2]

Department of Computer Science &Engineering, RCERT, Chandrapur[1, 2]

Abstract: In this paper we focus on finding the most optimal first transmission path and all transmission paths in duty cycled mobile WSN's employing geographical routing. The system introduces the concept of Load Calculation and delay as the main parameter in finding the optimal paths with Geographic Distance Based Connected k-neighborhood sleep scheduling algorithm. The WSN networks employing duty cycle technique in geographic routing has a task to find out the path from sensor to Base Station of the network to send the sensed data. GCKN for static WSN. Hence this research work proposes the system that will calculate the best optimal path from source node to destination by taking into consideration the load on each node and delay incurred by each node in Duty-Cycled Mobile sensor networks along with geographic routing.

Keywords: Geographic Routing, Sleep Scheduling, Duty –Cycled Mobile Sensor Network, Network simulator-2 (NS2)

INTRODUCTION

Recent studies show that Geographic routing is the most important routing in wireless sensor networks (WSNs) as it serves with its simplicity, scalability, and efficiency. This routing principle relies on geographic position information. Location information is used to formulate an efficient route search toward the destination. It is much attractive for large multi-hop wireless networks in which the nodes are not reliable and their network topology is frequently changing. This type of routing only requires the propagation of single hop topology information, i.e. the best neighbor, to make correct forwarding decisions. Geographic routing is one of the most promising techniques due to its simplicity, scalability, and efficiency.

We are proposing a new scheme to minimize transient delay among node, resulting in reduce duty-cycle, low energy consumption and minimized network latency. Proposed system is designed by keeping the multipath broadcast methodology for data sinking for receiving end. This will create multiple path for transferring data from sender to receiver and every path and every node will auto decide to go in sleep and wake up state after communicating with each other. This will solve data flooding problem, improve network efficiency and save energy

Some advantages of Geographic Routing are as follows:

- High mobility support decides the system efficiency. Each node sends its data to its coordinates periodically and all its neighbors update their routing tables accordingly. Thus all nodes are aware of its alive neighbor nodes.
- Scalability- It is also an important factor for geographic routing. The size of routing table depends on network density and not on network population. Hence, wider network with large number of nodes can be used without cluster formation.
- Minimum overheads- All the interaction in the network are localized. This results in bandwidth minimization. It saves processing and transmission of energy and reduces routing table dimension. Instead of using the network address, a message is sent to the geographic location of destination by the source. The determination of routing path from source to destination is by forwarding the selected node at each intermediate node in a fully-distributed manner. Thus the forwarding decision is determined purely on the basis of the location of each node instead of the network size.

Geographic routing is usually based on distance as its main parameter. This routing uses geographic routing oriented sleep scheduling (GSS) & geographic-distance-based connected-k neighborhood (GCKN) algorithm. But Geographic routing using distance as a parameter has many disadvantages too. The path selected using distance as a parameter causes delay and increases retransmission cost. The existing research was done to find out the shortest path from source to destination in Duty-Cycled Mobile sensor networks along with geographic routing as shown in fig 1. But, there may be the case where the path is shortest and the nodes are heavily loaded. Therefore, all these works overlook the fact that Load balancing is equally important factor. Thus, there is no load consideration in the earlier research. It leads to increase in Delay and transmission cost, decreases packet delivery ratio, throughput and hence the shortest path obtained is not optimal. These are some of the problems identified in the existing work. Hence, the need of research is to explore the various possibilities to determine the best optimal paths with load balancing. All paths in Duty-Cycled Mobile sensor networks along with geographic routing and network efficiency can be explored. The structure of this paper is as follows Section II surveys work related to our proposal. Section III describes the proposed system. Section IV describes implementation to determine the best optimal paths along with load balancing. Lastly section V presents the results.

II. RELATED WORK

According to the taxonomy presented by Chunsheng Zhu, Laurence T. Yang, Lei Shu, Joel J. P. C. Rodrigues and Takahiro Hara in [2], a geographic routing oriented sleep scheduling (GSS) is proposed in order to deal with the latency issue imposed by duty cycling on geographic routing. The author examined the working of first transmission path of the two-phase geographic forwarding (TPGF) in a CKN based WSN and proposed a geographic routing oriented sleep scheduling (GSS) algorithm to reduce the first transmission path of TPGF in duty-cycled WSNs. TPGF can be executed repeatedly to find multiple paths and nodes in any path explored by TPGF cannot be reused, which makes the first transmission path of TPGF have access to all neighbor nodes thus tend to be the shortest and most likely utilized path compared with other paths. As geographic routing is moving towards sensor networks with duty-cycle, it can be used to save energy consumption which is a very important design factor in practical WSN application scenarios.

In [3] Can Ma1, Lei Wang1, Jiaqi Xu1, Zhenquan Qin1, Ming Zhu1, Lei Shu discussed about topology coverage problem. The paper, focus on achieving better energy conservation for geographic routing algorithms in duty-cycled

WSNs when there is a mobile sink. Thus, the author proposed a multi-metric geographic algorithm (MMGR) which uses multi-metric candidates (MMCs) for geographic routing. However existing researches is either concern with duty-cycle or with mobile sinks, but MMGR considers the both aspects in geographic routing, for energy conservation.

The author Chunsheng Zhu, Laurence T. Yang, Lei Shu, Victor C. M. Leung, Joel J. P. C. Rodrigues and Lei Wang in[4] have explored geographic routing in duty-cycled mobile WSNs. They proposed two Geographic-distance-based Connected-k Neighbourhood (GCKN) sleep scheduling algorithms for geographic routing schemes to be applied into duty-cycled mobile WSNs. It can include the advantage of sleep scheduling and mobility. The first geographic-distance-based connected-k neighbourhood for first path (GCKNF) sleep scheduling algorithm minimizes the length of first transmission path explored by geographic routing in duty-cycled mobile WSNs and the second geographic-distance based connected-k neighbourhood for all paths (GCKNA) sleep scheduling algorithm reduces the length of all paths searched by geographic routing in duty-cycled mobile WSNs. Both the algorithms are very effective in shortening the length of the transmission path explored by geographic routing in duty-cycled mobile WSNs compared with the CKN sleep scheduling algorithm and the GSS algorithm. Sleep scheduling is a worthy research direction to adapt geographic forwarding methods into duty-cycled mobile WSNs. It will also be helpful in finding the optimal path in the proposed system.

In [5], Pedro Pinto, António Pinto, Manuel Ricardo proposed a novel real-time and end-to-end delay estimation mechanism, which considers processing times and two new RPL metrics. Current research focus on EED estimation by using probabilistic estimation of delays, network calculus, or routing metrics. But a novel EED estimation mechanism that combines path delays and node processing delays .The concept of delay will help us in our proposed system to find out the optimal path.

In [6], the basic principal of Packet forwarding in geographic routing is done by using intelligent forwarding geographic routing protocol called GPSR. Despite of several advantages, original greedy forwarding technique it causes congestion problem. Thus the author BiJun Li, MinJung Baek, SeUng Hyeon, and Ki-Il Kim proposed new parameters to balance load and to avoid congestion problem. For this the author used two parameters i.e. Node stress and Link Quality. The node stress is related to how much overheads are expected to be caused at each node whereas link quality is related to current wireless link status between adjacent nodes. As low quality wireless medium causes several problems on the links, therefore, new parameter to consider link quality is required. Hence the author introduced Packet Delivery Ratio as an important parameter for Load balancing..Thus we can conclude that PDR can be used as an important parameter in our proposed system.

In [7], Packet Delivery Ratio (PDR) as a metric to select the best route and transmission rate. It is estimated either by counting the number of received hello/data messages in a small period of time, or by taking the history of PDR into account. But fails to achieve good accuracy. Thus we propose a novel estimation method which takes advantage of receiving signal strength. But the results obtained by this method are satisfactory. Hence we use PDR Estimation using Received hello Packets method to estimate PDR in our proposed system.

III. PROPOSED SYSTEM

The proposed system focuses finding the most optimal first transmission path and all transmission paths in duty cycled mobile WSN's employing geographical routing. The system introduces the concept of Load Calculation and delay as the main parameter in finding the optimal paths with Geographic Distance Based Connected k-neighborhood sleep scheduling algorithm.

In the methodology of finding optimal path, firstly, neighboring nodes of source is searched. The neighboring nodes are searched using Distance as main criteria. The load of the individual neighboring nodes of source is then calculated. Calculation of Load involves Packet Delivery Ratio (PDR) as the important parameter. Then for the same set of neighboring node we calculate the delay. Delay and PDR are chosen as main parameter as it plays an important role in maintaining efficiency of a network.

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Slight increase or decrease in the parameter directly affects the network efficiency.
Thus, by using all the three parameter, we get the set of nodes arranged in increasing order of distance say S1, set of nodes arranged in increasing order of delay say S2, and set of nodes arranged in increasing order of PDR (as PDR is inversely proportional to load) say S3. Finally, a node will be selected from the three sets in each iteration.

Working System:
Distance Calculation:-
Initially we find the distance between the neighboring nodes. The distance between the two nodes and all the neighboring nodes is calculated by using two geographic-distance-based connected-k neighborhood (GCKN) sleep scheduling algorithms. These GCKN algorithms incorporate the connected-k neighborhood requirement and geographic routing requirement to change the asleep or awake state of sensor nodes. Thus we get set of nodes sorted according to distance.

Delay Calculation:-
Delay is an important Quality Of Service (QoS) parameter for forwarding data in a time constraint WSNs environment. The delay occurred at each node is calculated by sending hello packets. Initially few packets are sent from source to the neighboring nodes. The values of sending time and receiving time of packets are obtained from the trace file in Network Stimulator- 2.35. Then, by using the formula “Sending time – Receiving time,” delay occurred at each node is obtained. Finally delay from the set of neighboring nodes is calculated and the node in the set is arranged in increasing order of delay.

Packet Delivery Ratio:-
PDR is one of the newest parameters which can be used for load balancing in WSN. It comes under Link quality attribute. The PDR gives a better view of which nodes among the selected nodes have performed well in terms of reception of packets from the source of the packet. Higher PDR also ensures that the packets will be sent/ received with utmost efficiency which will reduce the cost of resending the packets if the PDR for certain node is on the lower side.

Optimal Path Finding:-
Initially a set of nodes obtained from delay calculation is compared with the set of nodes obtained from PDR calculation. Each set of node will consist of the first node having least delay and highest PDR respectively. Every single node of the first set is compared with the other set. The comparison results in obtaining a set of sorted nodes having moderate delay and moderate PDR.
Now this set obtained is then again compared with set of node arranged in increasing order of distance. If the case n <L is false then the node will be rejected and if the case is true then the node “ n “will be selected and will be placed in the final set as shown in the figure. Thus every single node of the first set is compared with the other set. The final set of nodes obtained after the comparison is then arranged in ascending order and first node of the set is selected as the next hop.

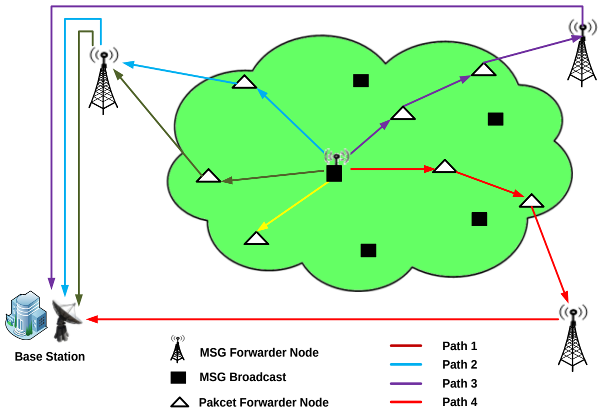

Fig 1

Describe the overall proposed process of system. Here it shows three main entities.

1. MSG forwarder node: this will transfer the message from wireless sensor node to base station
2. MSG broadcast Node: this will generate the actual message and work as a sink node
3. Packet forwarder node: this will goes in sleep or wake state and work as a packet forwarder node

IV. DESIGN AND IMPLEMENTATION

Outcomes
Here only outcomes of total numbers of nodes that are 50 nodes have been included. Network Simulator 2 is used for simulation. The fig.2,shows the sample screenshot (network animator - nam) while running the program in ns2. The nam window shows the delivery of data from source to destination. The version used is ns-2.31.Simulation is performed in wireless environment. . The following outcomes are obtained during each phase:

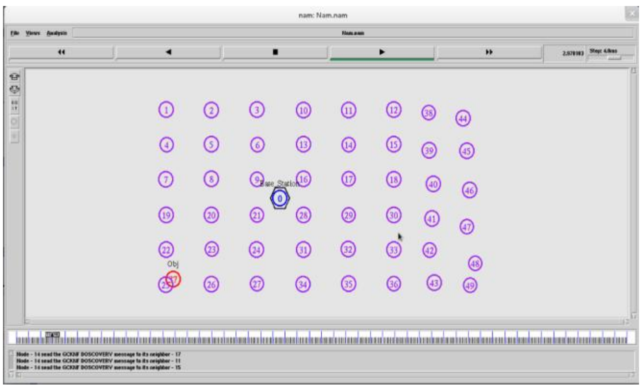
Fig 2

The object is shown in red color near the source. Here, the object is mobile and rest of the node is stationary. Initially GCKN message is sent to all the node to find out whether the nodes are in sleep state or awake state. By

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using sleep scheduling, the nodes which are not in use is made to sleep and thus conserving the energy of network.

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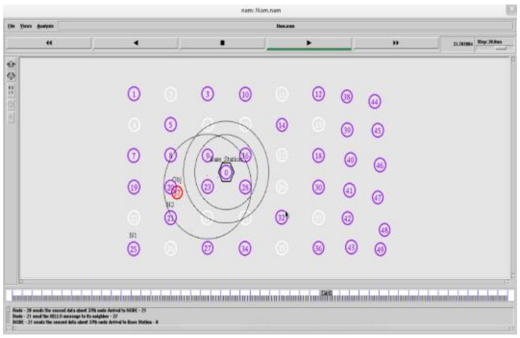

Fig 3

Then node 25 is source node and node 22, 23 & 26 are its neighbours. Thus based on the proposed methodology node 23 (black) is selected as the next hop which is having moderate delay ,distance & PDR respectively. Next hop selection is from node 21,the distance, delay and PDR of all the neighboring nodes is calculated by using the proposed methodology.

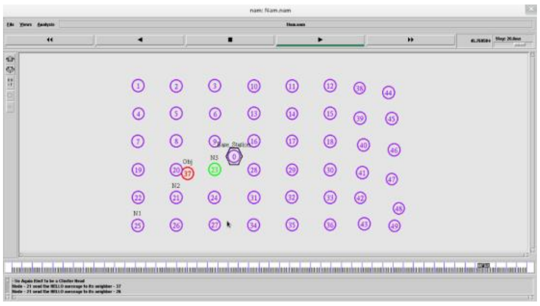

Fig 4

From the set of neighboring nodes (20, 23, 24), nodes 23 is selected to be the next hop node.

V. RESULT ANALYSIS

The fig 5 shows the improvement of throughput with respect to time in proposed system over existing system. X-axis indicates stimulation time and y-axis indicates throughput values. With the increase in time the throughput of the network also increases simultaneously. The graphical analysis shows that the proposed system is more efficient than the existing system.

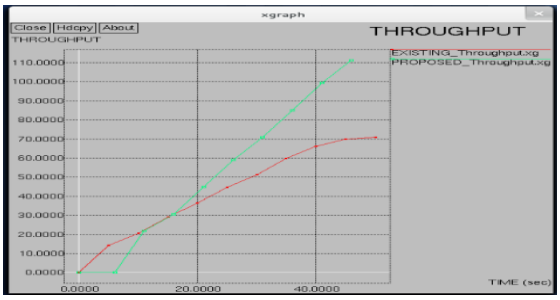

Figure 5 Throughput vs. time Graph Screen

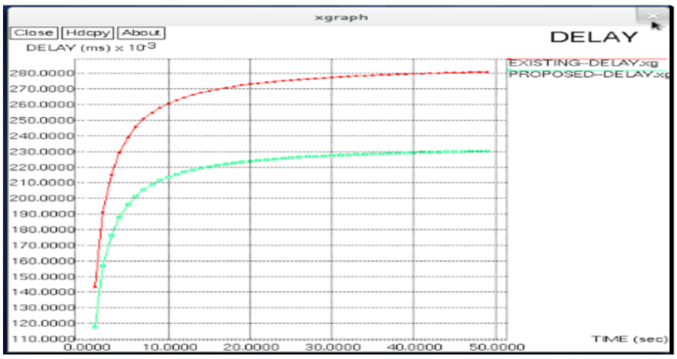

Figure 6 Comparison Graph Screen

The above graph shows comparison between the existing system and proposed system using Delay as a parameter where X-axis indicates simulation time and Y-axis indicates delay values. These values are calculated by using formula sending time- receiving time. The graphical analysis shows delay incurred in existing system is more than the proposed system.

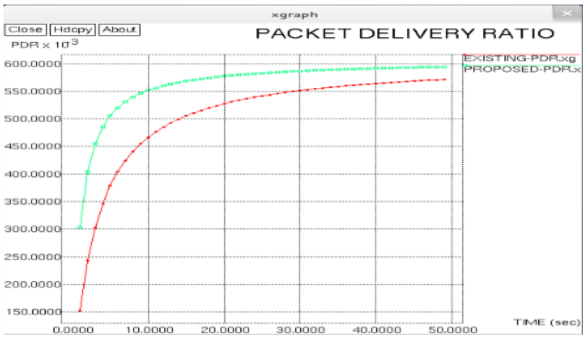

Figure 7 Comparison Graph Screen

The above graph indicates improvement in PDR of proposed system with the existing system with respect to time. X-axis indicates simulation time and Y-axis indicates PDR values. If the nodes are heavily loaded then its PDR will be less and vice versa. The graphical analysis shows that the proposed system has higher PDR than the existing system.

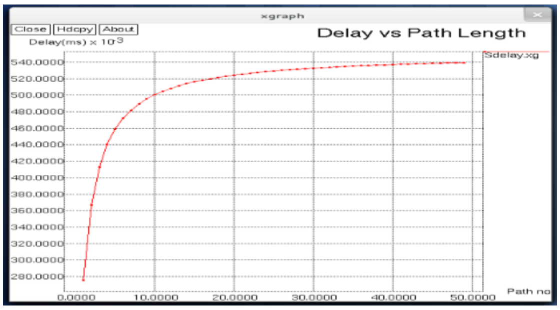

Figure 8 Delay Vs Path Length

The comparison graph of Delay vs path length shows that delay increases as the path length increases. This shows that delay is directly proportional to distance. X-axis in the above graph indicates path length. For calculating path length, distance from all 50 nodes is

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calculated. i.e 50 path from 50 nodes is calculated. Y-axis contains delay values of 50 paths.

VI. CONCLUSION

From performance analysis and experimental result the following conclusions and recommendation are drawn:

- This work focuses on finding optimal path in wireless sensor network with consideration of load and delay at every node. ns-2.35 is used for the optimal path calculations. The shortest path found by using distance as a parameter may result in delay, as the nodes along the path may be heavily loaded. Hence only distance parameter is not sufficient and thus we understand the motivation behind load consideration.
- Throughput, Delay and PDR are important QoS parameter. Slight increase or decrease in these parameter may affect network performance. Our simulation result shows considerable improvement over existing system, that takes distance as a parameter for optimal path finding.
- From the simulation results we can conclude that load and delay for optimal path finding, improves network performance.

Improvement in other network parameter can be worked out as the future enhancement of this work. This will improve the network performance.

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