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Collaborative Approach for Improving the Load Balancing In ADHOC Network

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Abstract: *Recent advances in Wireless Sensor Networks (WSN) have focused towards Geographic forwarding mechanism. It is a promising routing scheme in wireless sensor networks, in which the forwarding decision is determined purely based on the location of each node. Such type of Routing in Geographic domain is also useful for large multi-hop wireless networks where the nodes are not reliable and network topology is frequently changing. This routing requires propagation of single hop topology information that is the best neighbor, to make correct forwarding decisions.The research of Geographic routing has now moved towards duty cycled wireless sensor networks (WSNs). In such type of network, sensors are sleep scheduled which helps in reduction of energy consumption. It works by dynamically putting the nodes to sleep when not in use and reactivate it, when required, by using some sleep scheduling algorithms. Geographic routing is usually based on distance which is considered as its main parameter. This routing uses geographic routing oriented sleep scheduling (GSS) algorithm & geographic-distance-based connected-k neighborhood (GCKN) algorithm. 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, using distance as a parameter. But there may be the case when shortest path is available and the nodes are heavily loaded. Therefore, load balancing also proves to be equally important factor. 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*.

I. Introduction

Recent study shows that Geographic routing is the most important routing in wireless sensor networks (WSNs). It serves with simplicity, scalability, and efficiency. This routing principle relies on geographic position information. To improve the efficiency of route search towards destination, location information is used.Routing in Geographic domain is also useful for large multi-hop wireless networks where the nodes are not reliable and network topology is frequently changing. This type of routing requires propagation of single hop topology information that is the best neighbor, to make correct forwarding decisions [1].

The efficiency of this scheme is decided by Network density, accurate localization of nodes and the forwarding rule.

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.

The research of Geographic routing has now moved towards duty cycled wireless sensor networks (WSNs). Duty Cycled WSN aims at reduction in use of power consumption. According to some sleep scheduling algorithm, some nodes are made to sleep and awake alternately. It selects a specific node while the other nodes in the network are inactive. Thus it leads to lesser power consumption.

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.

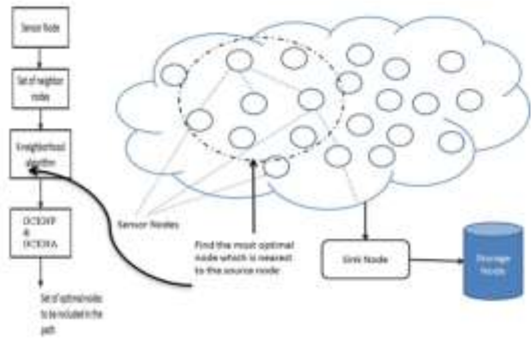

Figure: 1. Scenario of Existing System

II. Literature Review

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, MinJungBaek, SeUngHyeon, 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.

III. Existing System:

1. The existing system focuses on Sleep Scheduling problem which occurs in duty cycle Wireless Sensor Networks when geographic routing is used.
2. This system attempts to find out the first transmission path and all transmission paths in a duty cycled WSN. Finding this path is viewed as an extension to the Geographic Routing algorithm. Following are the two approaches introduced in the existing system to achieve the above mentioned paths.

i. Geographic Distance Based Connected k-neighborhood for first transmission path. (GCKNF)
ii. Geographic Distance Based Connected k-neighborhood for all transmission path (GCKNA).

For both of the above approaches the system incorporates k-neighborhood graphs in the geographic routing.

3. The system by deploying above two approaches aim to achieve shorter average lengths for first transmission paths searched in Mobile WSN's using GCKNF sleep scheduling and all transmission paths explored in mobile WSN's using GCKNA sleep scheduling.
4. The system also analyzes the sleep scheduling algorithm for geographical routing duty cycled mobile WSN in order to acquire full benefits of duty cycling and sensor mobility.

IV. Proposed System

Objectives:-

1. The system focuses on finding the most optimal first transmission path and all transmission paths in duty cycled mobile WSN's employing geographical routing.
2. The system introduces the concept of Load Balancing as one of the factors to be considered for finding the optimal paths along with Geographic Distance Based Connected k-neighborhood sleep scheduling algorithm.
3. The proposed scheme considers Packet Deliver Ratio as a parameter for load balancing. PDR will be calculated for each of the nodes which are found using GCKNF and GCKNA. Then among those nodes, the nodes which are having better PDR will be selected to be included in the path.
4. 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.
5. 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.
6. The complete system evolves to a Novel approach which will help in reducing the end to end delay and throughput of the duty cycled mobile WSN using geographical routing.

V. Proposed Methodology

We consider the following six factors for both GCKNF and GCKNA.

1. A node should go to sleep assuming that at least k of its neighbors will remain awake so as to save energy as well as keep it k-connected .
2. The asleep or awake state of nodes should be allowed to change between epochs so that all nodes can have the opportunity to sleep and avoid staying awake all the time, thus distributing the sensing, processing, and routing tasks across the network to prolong the network lifetime.
3. Although each node decides to sleep or wake up locally, the whole network should be globally connected so that data transmissions can be performed.
4. Each node should have enough initial neighbors in order to make it easier for the node to satisfy the connected-k neighborhood requirement; thus, it is more likely to be asleep after sleep scheduling. For GCKNF, which emphasizes the first transmission path of geographic routing, we further take the following factor into account.
5. The neighbor of each node, which is closest to sink, should be awake so that geographic routing can utilize these nearest neighbor nodes to make the first transmission path as short as possible. For GCKNA, which considers all transmission paths, we further take the following factor into consideration.
6. For each node, as many as possible of its neighbor nodes that are closer to the sink should be awake so that geographic routing can make all transmission paths as short as possible

Pseudocode of GCKNF algorithm First:
Run the following at each node u.
1) Send probe packet pu to neighbors and receive the ack packet.
2) Compute whether u's current neighbors CNu ≥ min(k, du).
3) Maintain its transmission radius if the above the condition holds or its current transmission radius is maximum. Otherwise, increase its transmission radius until CNu ≥ min(k, du).
Second: Run the following at each node u.
1) Get its geographic location gu and sink location gs .
2) Broadcast gu and receive the geographic locations of its all neighbors Au. Let Gu be the set of these geographic locations.
3) Unicast a flag to w, w ∈ Au and gw is the closest to sink in Gu.
Third: Run the following at each node u.
1) Pick a random rank ranku.
2) Broadcast ranku and receive the ranks of its currently awake neighbors Nu. Let Ru be the set of these ranks.
3) Broadcast Ru and receive Rv from each v ∈ Nu.
4) If |Nu| < k or |Nv | < k for any v ∈ Nu, remain awake. Return.
5) Compute Cu = {v|v∈ Nu and rankv<ranku}.
6) Go to sleep if the following three conditions hold. Remain awake otherwise • Any two nodes in Cu are connected either directly themselves or indirectly through nodes within u's two-hop neighborhood that have rank less than ranku. • Any node in Nu has at least k neighbors from Cu. • It does not receive a flag.
7) Return

Pseudocode of GCKNA algorithm
First: Run the following at each node u.
1) Send probe packet pu to neighbors and receive the ack packet.
2) Compute whether u's current neighbors CNu> min (k, du).
3) Maintain its transmission radius if the above condition holds or its current transmission radius is the maximum. Otherwise, increase its transmission radius until CNu ≥ min(k, du).
Second: Run the following at each node u.
1) Get its geographic location gu and sink location gs. Further get the geographic distance between itself and sink granku.
2) Broadcast granku and receive the geographic distance ranks of its currently awake neighbors Nu.LetRu be the set of these ranks.
3) Broadcast Ru and receive Rv from each v ∈ Nu.
4) If |Nu| < k or |Nv| < k for any v ∈ Nu, remain awake. Return.
5) Compute Cu = {v|v∈ Nu and grankv<granku}.

6) Go to sleep if both the following conditions hold. Remain awake otherwise. • Any two nodes in Cu are connected either directly themselves or indirectly through nodes within u's two-hop neighborhood that have grank less than granku. • Any node in Nu has at least k neighbors from Cu.
7) Return.

Analysis of GCKN Algorithms Theorem:
Node u will have at least min (k, ou) awake neighbors after running GCKN algorithms, if it has ou neighbors in the original network.
Proof: If ou $<$ k, all of u's neighbors should keep awake (Step 4 of the third part of GCKNF or Step 4 of the second part of GCKNA) and the node will have ou awake neighbors. Otherwise, when ou $\geq$ k, we prove the theorem by contradiction.
Suppose that node u will not have at least k awake neighbors after running GCKN algorithms, i.e., we can assume that the i'th lowest ranked (for GCKNF) or granked (for GCKNA) neighbor v of u, i $\leq$ k, decides to sleep.
Then Cu will have at most $i - 1$ nodes that are neighbors of u. But since $i - 1 < k$, v cannot go to sleep according to the Step 6 of third part of GCKNF or Step 6 of second part of GCKNA.
This is a contradiction. In other words, the k lowest granked neighbors of u will all remain awake after running the algorithm, and hence, u will have at least k awake neighbors.

Theorem 2:
Running GCKN algorithms produces a connected-network if the original network is connected.
Proof: We prove this theorem by contradiction. Assuming that the output network after running GCKN algorithms is not connected.
Then, we put the deleted nodes (asleep nodes decided by GCKN algorithms) back in the network in ascending order of their ranks (for GCKNF) or granks (for GCKNA), and let u be the first node that makes the network connected again.
Note that by the time we put u back, all the members of Cu are already present and nodes in Cu are already connected since they are connected by nodes with rank <ranku (for GCKNF) or grank<granku (for GCKNA).
Let v be a node that was disconnected from Cu but now gets connected to Cu by u. But this contradicts the fact that u can sleep only if all its neighbors (including v) are connected to $\geq$ k nodes in Cu (Step 6 of third part of GCKNF or Step 6 of second part of GCKNA).
Theorem: GCKN sleep scheduling-based WSN can provide as short as possible transmission path explored by geographic routing when there are mobile sensor nodes.
Proof: We prove this by analyzing the resultant topology after running GCKNF or GCKNA. Concerning GCKNF, given that there is a network Ngcknf resulting from GCKNF, based on the algorithm presentation of GCKNF, we can deduce that the neighbor node that is closest to the sink for any node, will be among the awake nodes of the Ngcknf (Step 6 of the third part of GCKNF).
In other words, no matter which node the geographic routing chooses to be the first forwarding node, all successor nodes closest to sink can be utilized by the geographic routing. Thus, the length of the first transmission path explored by geographic routing can be as short as possible. Regarding GCKNA, assume that there is a network Ngckna created by GCKNA.
From the algorithm description of GCKNA, we can determine that for any node, say u, if it determines to be asleep, it must make sure that either
1) its all awake 1-hop neighbor nodes are connected by themselves with grank<granku or connected by their two-hop neighbor nodes with grank<granku;
2) any of its awake one-hop neighbor nodes should have at least k neighbor nodes from the subset of the one-hop neighbor nodes with grank<granku (Step 6 of the second part of GCKNA). This means that compared with the asleep nodes, the awake nodes generally have closer geographic distance to the sink. In other words, geographic routing can have access to as many as possible closer neighbor nodes to the sink under the priority of network connectivity after sleep scheduling. Thus, the length of all transmission paths searched by geographic routing can also be as short as possible.

VI. Proposed System Suimulation Parameter

Simulation parameters for Sleep sceduling project

Routing protocol	DSDV
Simulation time	50 seconds
Simulation area (m x m)	1350 x 1130
Number of Nodes	47
Traffic Type	CBR
Performance Parameter	Throughput, delay, PDR,
Pause time	0.2 seconds
Packet Inter-Arrival Time	exponential(1)
(s)	512
Packet size (bits)	0.006
Transmit Power(W)	512 KBPS
Date Rate (Mbps)	TDMA
scheduling	PRIORITY queue
Queue model	802.11, 802.16
MAC	Wireless channel
Channel type	200 joules
Energy level	OMNI ANTANNA
ANTANNA TYPE	TWO RAY GROUND
RADIO PROPOGATION	PROPOGATION

VII. Conclusion

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 QoSparameter.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.

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