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AN ENERGY EFFICIENT SLEEP SCHEDULING FOR MOBILE SENSOR NETWORKS USING TARGET PREDICTION

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***Abstract*--MANET is based of infrastructure less ad hoc network that usually has routable environment between nodes and potentially contains multiple hops. Nodes update their position of their immediate neighbors and make effective forwarding decisions. It overcomes the cost updates and provide good routing performance using MP rule(mobility prediction) and ODL rule(on demand learning).It exposed with a problem of the load balance in its localized topology and it is solved by the Load Aware Routing Protocol(LARA) to reduce the load in topology. This is performed by reducing the traffic density of neighboring nodes and calculating the traffic intensity. Finally it selects the destination route where the traffic cost is minimum.**

Index Terms: **Load Balance, Location Update, Traffic Density, Cost Reduction**.

I. INTRODUCTION

The devices that do not depend upon centralized or organized connectivity has led to the development of MANET. These are infrastructure-less network where each node is mobile and independent of each other. Due to the unorganized connectivity and dynamic topology, routing in the MANET becomes the challenging task. Moreover constraints like lower capacity of wireless links, error prone wireless channels, limited battery capacity of each mobile node. Degrade the performance of the MANET routing protocol. Heavy loaded nodes may cause congestion and large delays or even deplete their energy quickly. Routing protocols that can evenly distribute the traffic among mobile nodes and hence improve the performance of MANET are needed.

Routing protocols in MANET are classified in three categories proactive, reactive and hybrid routing protocols. Prominent routing protocols use AODV [1], DSR [2] and use hop count as the route selection metric. It may not be the most efficient route when there is congestion in the network. It may lead to undesirable effects such as longer delays and lower packet delivery and high routing overhead. Also some nodes that may lie on multiple route spend most of the energy in forwarding packets and deplete their energy quickly.

In this paper we present novel load balancing mechanisms and schemes for MANET that focus on distributing the traffic on basis of combination of forwarding three metrics.

1. Hop count.
2. Residual battery capacity.
3. Average number of packets queued up in the interference queue of a node lying on the path from source to destination/traffic queue.

These three metric along with associated weight values decide the path to be selected for data transmission. DLAR [3] and LARA [4] in terms of average delay ,packet delivery are proposed for load balanced and ad -hoc routing.

II. RELATED WORKS

Load balance routing aims to move traffic from the areas that are above the optimal load to less loaded areas, so that their entire network achieves better performance. If the traffic is not distributed evenly, then some areas in a network are under heavy load. While some are lightly loaded or idle. There are various proposed algorithms for load balanced routing. In Dynamic Load Aware Routing [DLAR] Protocol routing load of a route has been considered as the primary route selection metric.

The load of a route is defined as the summation of the load of nodes on the route, and the load of a node is defined as the number of packets buffered in the queue of the node. To utilize the most up to date load information when selecting routes and to minimize the overlapped routes which cause congestion bottleneck, DLAR prohibits intermediate node from replying to route request message.

Another network protocol for efficient data transmission in mobile ad-hoc network is [LARA] Load Aware Routing in ad-hoc Protocol. In LARA during the route discovery procedure, the destination node selects the route taking into account both the number of hops and traffic cost of the route. The traffic cost of a route is defined as the sum of the traffic queues of that particular route. Thus, the delay suffered by a packet at a node is dependant not only on its own interference queue but also the density of the nodes.

All the protocols discussed above concentrate on traffic balancing and do not emphasize on energy issues. A number of routing protocols that consider energy issues in MANET have been proposed. On the basis of route selection criterion there are mainly two categories of the energy efficient routing protocols. The first class selects the path that consumes the least energy to transmit a single packet from source to destination aiming at minimum the total energy consumption along the path. The second one intends to protect the over used nodes against breakdown, aiming at maximum the whole network lifetime.

III. PROPOSED SCHEMES TO ACHIEVE LOAD BALANCING

A number of routing protocols proposed for MANET use shortest route in terms of hop count for data transmission. It may lead to quick depletion of resources of nodes falling on the shortest route

It may also result in network congestion resulting in poor performance. Therefore, instead of hop count a new routing metric is required that can consider the nodes current traffic and battery status a routing path that consist of nodes with the higher residual power and hence life longer.

The required parameters used are defined in the following

1. Route energy: (RE) the route energy of a path is the minimum of residual energy of the nodes falling on the route. Higher the route energy lesser is the probability of the route failure due to the exhausted nodes.
2. Traffic queue: (TQ) the traffic queue of a node is no of packets queued up in the node interface. Higher the value, more no of nodes is occupied.
3. Average Traffic Queue: (ATQ) It is the mean of traffic queue of the node from the source to destination node. It indicates load on a route and helps in determining the heavy loaded route.
4. Hop Count: (HC) The Hop Count is number of hops for a feasible path.

SCHEME 1:

The first scheme proposed is to determine the routes in such a way that the routes consisting of nodes with lower residual battery capacity are avoided for data transmission even if they are short and less congested. This stage tries to make a fair compromise between three route selection parameter that is hop count, residual battery power or capacity and the traffic load.

A MANET can be represented as an undirected graph. G(V,E) where V is the set of nodes (vertices) and E is the set of links (edges) connecting the nodes. The nodes may die because of depleted energy source and the links can be broken at any time owing to the mobility of the nodes. V n|nEV, n has an associated traffic queue tq (n) and residual battery energy re_i. A path between two nodes U and V is given as

P (u ,v) = (u ,e(u, x),x ,e(x ,y),y,…..,e(z, v),v)

It an emphasized that a path between any two nodes is a set consisting of all possible paths between them. Formally, p (u,v) = {p0,p1,….pn} where each path pi is a candidate path between u and v.

Let HC(pi) be the hop count corresponding to the path pi between u and v. Weight of the path pi between U and V. Weight of the path pi defined as

W(pi) = w1* RE(pi) – w2 * ATQ(pi) – w3 * HC(pi). -->(1)

Where RE(pi)=min $(re_{n1,}re_{n2},…,re_{nm)}$ and n1,n2,……nm are the nodes making up the path.

ATQ(pi)=(tq(n1)+tq(n2)+…..tq(nm))/m-1 →(2)

The field having adverse contribution to traffic distribution is built into negative coefficient in equation 1. Also the weighted values are calculated such as w1+w2+w3=1.

The idea is to find a path from source to the destination with maximum weight such that from the beginning the path. Determined is energy efficient and there is a fair compromise between a short route and a light loaded route. In this stage RE has been given the maximum weight age. That is w1 is maximum and w2 and w3 are equal. This path is called as Energy Aware Load Balanced Path (EALP).

Supposing that {1,2,3,…..n}, p(s,d)={p0,p1,p2,…..pn} for the given source s and the destination d we can define that EALP(sod)=pi with w(pi)=max{w(pi),w(p2),…w(pn)} →(3) w1,w2,w3 are constants.

In proposed scheme route are determining on demand. A source node initiates the route discovery process by broadcasting a route request (RREQ) packet whenever it wants to communicate with another node for which it has no routing information in its table. On receiving a RREQ packet, a node checks its routing table for a route to the destination node. If the routing table contains the latest route to the destination node, the intermediate node sends a destination node sends a RREP packet along the reverse path back to source node also appending the weight value for the route. When a source node receives more than one RREP packet for RREQ, it compares the weight value of the route and selects the route with maximum weight. However, if an intermediate node has no information of the destination node, it adds its own traffic queue value, compare and finds the minimum of residual battery capacity field of RREQ packet, increments the hop count by one and rebroadcast the route discovery packet when destination mode receives a route request packet, it waits for a certain amount of time before replying with a RREP packet in order to receive other RREQ packets. Then destination node computes ATQ and the weight value for each feasible path using equation 2 and using weight function as given in equation 1 respectively. The route with highest weight value is selected as the routing path and a RREP packet is sent back towards the source node and the selected path.

In the algorithm discussed above weight values are constant, which is limited as when route selection procedure starts. There are more chances of network congestion because of flooding of many RREQ packets simultaneously. Moreover nodes have maximum battery energy during the initial phases. Therefore the requirement is to change the above algorithm such that when the battery energy of the node is high, emphasis is on selecting a short and light loaded route. As there battery energy of nodes decreases we tend to conserve energy compromising on short and lightly loaded route.

SCHEME II:

Another scheme has been proposed in this paper in which weight values (w1, w2, w3) are adaptive to the network status, instead of being constant. More weight age is given to find short and less congested routes during initial route discovery procedure, as the possibility of network congestion is high due to the flooding of many RREQ packets simultaneously. Also, nodes have maximum battery energy during initial phases.

However as the time elapses battery energy of the node decreases, therefore we tent to conserve energy, compromising on short and lightly loaded routes. The adaptive behavior of the protocol has been implemented by computing the proportion of route energy and initial energy of nodes assuming that all nodes are similar with equal initial battery energy. Therefore as per scheme 2 , weight value of a route is computed as

W(pi)=(i-x)*RE(pi)-x/2*(ATQ(pi)+HC(pi)) →(4)

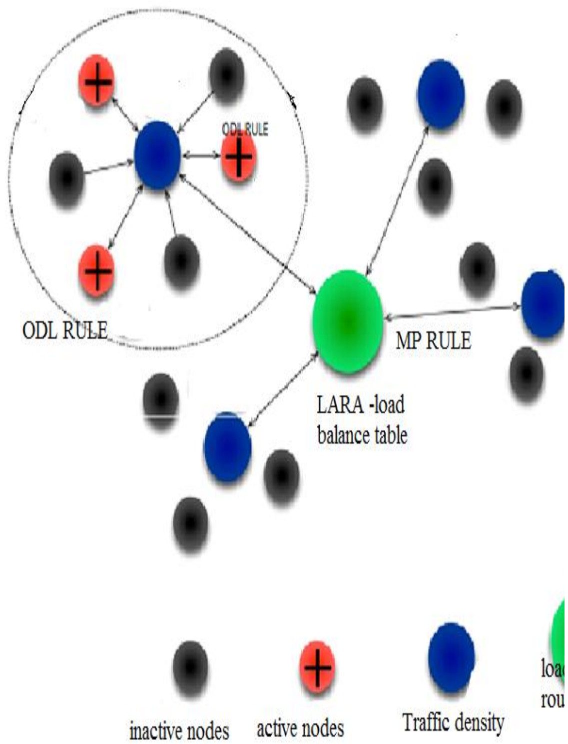
Where x=min (RE(pi))/IE;0<=x<=1→(5)

And gives the proportion of battery capacity left. Initially when nodes have high residual battery energy x is maximum, route selection is mainly done on the basis of hop count and average traffic load as can be seen from equation(4). As nodes battery energy decreases with the passage of time x decreases and 1-x increases loading to more weight age to the route energy parameter.

SCHEME III:

The schemes proposed next uses location information to limit the broadcast of RREQ packets. When an intermediate node receives a RREQ packet it uses the location information before broadcasting the RREQ packets further. Only the node that are closer to the destination than the source node are allowed to broadcast RREQ packets further. By doing a broadcast storm can be avoided resulting in less congested routes.

A source node while starting a route discovery process, computes its distance write to the destination node, appends this value in the RREQ packet along with the field as used in the scheme(2) and broadcasts its further. An intermediate node on receiving a RREQ packets compares its distance to the destination node with the distance value stored in the RREQ packet. If its distance is longer, it drops the RREQ packet else it compares energy value in the packet. It also adds its own traffic queue to the traffic queue already recorded in the packet and updates hop count by 1. It broadcast the packet further. By doing so only those nodes that are closer to the destination node than the source node participate route selection procedure resulting in reduced routing over head.



Performance evalution:

In this section we describe our simulation environment and performance metric

IV. PERFORMANCE METRIC

Here NS-2 simulator version 2.29 to analyze the proposal algorithms. Our solutions has been compared against AODV and two of the previously proposed load balanced ad-hoc routing protocols DLAR and LARA. The following performance metric to evaluate the performance of each scheduling algorithm.

1.PACKET DELIVERY FRACTION: It gives the ratio of the data packets delivered to the destination to those generated by the source, which reflects the degree of reliability of routing protocol.

2.NORMALIZED ROUTING LOAD: The number of routing control packets per data packet delivered at the destination.

3.AVERAGE END TO END DELAY: This is the average overall delay for a packet to traverse from a source node to a destination node. This includes the route discovery time, the queuing delay at a node, the transmission delay at the MAC layer, and the propagation and transfer time in the wireless channel. As delay primarily depends on optimality of path chosen, therefore this is a good metric for comparing the efficiency of underlying routing algorithm

a)JITTER: It is defined as the delay variation between each received data packets. It gives an idea about stability of the routing protocol.

b) Average Residual Battery Capacity: This metric depicts the amount of energy consumption of nodes with respect to time period.

c) Simulation Environment: Simulation consists of 50 nodes moving at maximum velocity 20m/s in 600m X 600 m grid area with a transmission range of 100 m with 25 and 37 TCP flows. Source node transmits packets at a rate of four packets per second, with a packet size of 1024 bytes. Each node moves to a random destination at random velocity. They stay there for predefined time and then move to a new destination. Also it is the most widely used mobility model in previous studies. The size of the interface buffer of each node for simulation is taken as 50 packets

V. SIMULATION RESULTS

The proposed schemes perform very well irrespective of nodes pause time and outperform AODR, DLAR and LARA. In high mobility scenario many route construction process are invoked. When a source floods RREQ packet to recover the broken route, many intermediate routes reply with the routes cached by overhearing packets during the initial route construction phase.

A number of these ached routes overlap existing routes. Nodes that are the part of multiple routes become congested and cannot deliver the packet further resulting in poor performance of AODV. The effectiveness of load balancing is not salient compared with our schemes. The performance of proposed schemes is almost similar. The reason for lower packet delivery fraction at some points for third scheme is inability of the network to find out a route to the destination because of the restricted number of RREQ packets. The results also show that the packet delivery fraction reduces with increase in load in the network.

VI. NORMALIZED ROUTING LOAD

As expected, normalized routing load for first two proposed schemes is comparatively higher than AODV protocol. The third proposed algorithm often routes the packet around heavily loaded nodes. DLAR and LARA make better choice of routes than AODV. The proposed algorithms makes best decisions among all these protocols. The results are more noteworthy because even for highly dynamic topology (pause time =0) and static topology (pause time =900) proposed algorithms achieves significant lower delay than three protocols. This is due to the effective routing strategy adopted for load balancing and their try to route packet along a less congested route to avoid overloading of some nodes.

JITTER:

we try to restrict the broadcast of RREQ packet, which results in lower routing load than the routing load of AODV,DLAR and LARA protocols

AVERAGE END TO END DELAY:

proposed algorithm have much improved average end to end delay than AODV and other two load balanced routing protocols. DLAR and LARA . We can see that the end to end delay increase for all the protocols with increase in load. The packet now have to wait longer in the interface queue before being transmitted . Here, AODV suffers maximum delay as it topology as well. This behavior is as anticipated because delay mainly occurs in queuing and medium access control processing. These delays are reduced in proposed schemes by routing the packets toward nodes that are less occupied also taking into account more efficient node in terms of energy.

AVERAGE RESIDUAL BATTERY CAPACITY:

The performance of other two protocols improves with the reduction in battery energy, because as the battery capacity of nodes decreases, routes with higher residual battery capacity are considered irrespective of its length and load. It is due to restricting the broadcast of packets as a result of which a proportion of energy spent by nodes in forwarding RREQ packets reminds conserved.

VII. CONCLUSION

we presented some schemes for load balancing in mobile ad hoc network. The proposed scheme are based on a new metric weighted combination of three parameters. The three parameters responsible for final route selection are the average Traffic queue , Route energy and Hop Count and the weight corresponding to these parameter may be fixed or adaptive to network status , depending about the load balance scheme. By taking these parameters together traffic is deviated from high loaded routes towards route processing higher energy and less loaded. In proposed strategies a load balancing routing path is selected among all feasible path on the basis of weight value calculated for each path. In a feasible path the higher weight value for traffic distribution. The performance the scheme is evaluated by simulation. the result simulation indicates that compared with the previous load balanced routing schemes DLAR and LBAR, the proposed scheme exhibits a better performance in both moderately loaded and highly loaded situations. in addition we have shown that the average residual battery capacity of nodes and hence network life time is higher in case of proposed scheme than AODV protocol.

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