OPTIMIZED ENERGY AWARE ROUTING SCHEME FOR MOBILE AD HOC NETWORKS

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Abstract - One important characteristic of MANETs is that the nodes are energy-constrained. Since, nodes are battery-operated, recharging frequently or replacing batteries may become undesirable or even impossible. The nodes in Mobile Ad-hoc Networks (MANET) are limited battery-powered. This not only leads to degradation in performance of the network but also reduces the lifetime of the network and in some cases makes the network partitioned. In order to maximize the lifetime of MANETs, routes having nodes with low energy and nodes with more buffered packets should be avoided, so, the energy efficiency is one of the primary metrics of interest. Energy efficient routing in MANETs is considered as a major issue.

In this Paper, a new energy efficient scheme in the routing protocol for mobile ad hoc network has been proposed which will efficiently utilize the battery power of the mobile nodes in such a way that the algorithm improves the network energy consumption and increases the lifetime of the network. The popular on demand routing protocols use shortest path between sources to destination without considering the energy of the intermediate nodes in the path. The proposed algorithm not only considers energy of the node while selecting the route but also takes into account the number of packets buffered in the node. More number of buffered packets means remaining energy will be less and time taken to deliver a packet will be more.

Keywords - Mobile ad hoc network; Routing Protocol; Energy Efficient Routing; Packet buffered;

I. INTRODUCTION

MANET has emerged as one of the most focused and thrust research areas in the field of wireless networks and mobile computing. In ad hoc mobile networks, routes are mainly multi hop because of the limited radio propagation range and topology changes frequently and unpredictably since each network host moves randomly. Therefore, routing is an integral part of ad hoc communications. Many routing protocols are proposed for MANET. The protocols are mainly classified in to three categories: Proactive, Reactive and Hybrid. Proactive routing protocols attempt to maintain consistent, up-to-date routing information from each node to every other node in the network. Reactive routing protocols create routes only when desired by the source node. Once a route has been established, it is maintained by a route maintenance procedure. Hybrid Routing Protocol which combines the merits of proactive and reactive approach and overcome their demerits.

Nodes in Ad Hoc networks should be enabled to manage efficiently their energy consumption to prolong the network lifetime [1]. The energy consumption of each node varies according to its communication state: transmitting, receiving, listening or sleeping state. Any power failure of a node will affect the overall network lifetime. As a result, energy efficiency should be taken into consideration as it is a critical and extensive research issue. Mobile phones, laptops and PDAs are the devices used as nodes in MANETs, as shown in figure 1. Researchers and industry both are working on the mechanism to prolong the lifetime of these devices. Hardware manufacturers are also coming forward to help in saving the battery power by making energy efficient devices like energy efficient CPUs, low
power display units, efficient algorithms for hardware processing and high density batteries.

One important characteristic of MANETs is that the nodes are energy-constrained. Since, nodes are battery-operated, recharging frequently or replacing batteries may become undesirable or even impossible. The nodes in Mobile Ad-hoc Networks (MANET) are limited battery-powered. This not only leads to degradation in performance of the network but also reduces the lifetime of the network and in some cases makes the network partitioned. In order to maximize the lifetime of MANETs, routes having nodes with low energy and nodes with more buffered packets should be avoided. So, the energy efficiency is one of the primary metrics of interest. Energy efficient routing in MANETs is considered as a major issue.

In this paper, a new reliable power aware routing scheme for mobile ad hoc network has been proposed which will efficiently utilize the battery power of the mobile nodes in such a way that the algorithm improves the network energy consumption and increases the lifetime of the network. The popular on demand routing protocols use shortest path between sources to destination without considering the energy of the intermediate nodes in the path. This can lead to path breakage if any node runs out of energy. The algorithm which does not always choose the shortest path between source and destination but choose such routing path that nodes have the maximum residual energy as well as shortest path and algorithm which not only considers energy of the node while selecting the route but also takes into account the number of packets buffered in the node. More number of buffered packets means remaining energy will be less and time taken to deliver a packet will be more.

A. Algorithm for Route Discovery process in RPAR

- When any node has data to send, it generates route request packet (RREQ) and floods it on the network with a common transmission range.
- The route request packet should carry two pieces of information: hop count and energy consumption.
- Search for all shortest (Minimum hops) routes.
- Among the shortest paths pick the route on which nodes have the maximum residual energy as well as minimum number of packets buffered in the node.
- Destination node sends the route reply packet (RREP) on selected route.
- The proposed scheme adds the following parameters in the header of route reply packet.
  1. Residual Energy Status (RES): the residual energy of the node.
  2. Buffered Packets (BP): the number of packets buffered in the node.

The algorithm does not always choose the shortest path between source and destination but chooses such routing...
path that has nodes with maximum residual energy as well as minimum number of packets buffered in the node among the shortest paths. In figure 3, nodes with blue color have more than 50% of remaining energy and nodes with light blue color (2 & 6) have less than 50% of remaining energy. The small circle with the nodes gives the number of buffered packets. As shown in figure 3, the shortest path from source node 1 to destination node 9 chosen by AODV is 1-2-3-9 (shortest hop), but due to low residual energy of node 2, it is not chosen. Node 5 and 6 also lie in the transmission range of source node 1. Out of the two, node 5 is chosen as it has the maximum residual energy, minimum packets in buffer and also it is nearest to source node 1. Thus the route 1-5-7-8-9 will be selected on the basis of above mentioned algorithm, which is more reliable and number of packets can be transferred before any node dies.

\[
e_c(T) = n_t \times a + n_r \times b
\]  
\[
e_r(T) = e_i - e_c(T)
\]

If (Residual energy) < 50%  
Then set RES = 0  
If Residual energy > 50%  
Then set RES=1

III. SIMULATION

In this section, it discusses some of the simulation parameters to measure the network performance.

A. Simulation Environment

The proposed model has considered an area of 1,000 mts × 1,000 mts with a set of nodes placed randomly. It simulated by using Network Simulator (NS-2.33). Here, each node is initially placed at a random position within the defined area. As it progresses, each node pauses current location for 2 sec and then randomly chooses new location. Each node maintains its behavior, alternately pausing and moving to a new location during the simulation time. The simulation parameters are shown in table I.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topology area</td>
<td>1,000 × 1,000 mts</td>
</tr>
<tr>
<td>Simulation time</td>
<td>2,000 sec</td>
</tr>
<tr>
<td>Traffic type</td>
<td>CBR</td>
</tr>
<tr>
<td>CBR packet size</td>
<td>512 bytes</td>
</tr>
<tr>
<td>Node mobility</td>
<td>0 to 20 mts/sec</td>
</tr>
<tr>
<td>Frequency</td>
<td>2.4 Ghz</td>
</tr>
<tr>
<td>Channel capacity</td>
<td>2 Mbps</td>
</tr>
<tr>
<td>Transmission range</td>
<td>150 mts</td>
</tr>
<tr>
<td>Transmission power</td>
<td>1,400 mW</td>
</tr>
<tr>
<td>Receiving power</td>
<td>1,000 mW</td>
</tr>
<tr>
<td>Idle power</td>
<td>830 mW</td>
</tr>
<tr>
<td>Mobility model</td>
<td>Random waypoint</td>
</tr>
<tr>
<td>Voltage</td>
<td>5 V</td>
</tr>
<tr>
<td>Pause time</td>
<td>1 sec</td>
</tr>
</tbody>
</table>
IV. RESULTS AND DISCUSSION

In order to evaluate the network performance, it uses the metrics such as network lifetime & energy consumption.

A. Network Lifetime
In this experimental setup, it considered 25 nodes, which are deployed within the defined area. Number of packets sent between 5–20 packets/sec and each node moved 2 mts/sec. Group size versus the network lifetime as shown in Fig. 1. From the results, it concludes that the proposed model is always kept maximum number of nodes alive for longer period of time as compared to others. If the group size is 12, then the proposed model has kept the nodes alive for 8,150 sec, whereas the MIP model and LAM model have kept the nodes at 7,450 sec and 6,455 sec, respectively.

Fig. 3. Group size nodes versus Network Lifetime

B. Energy Consumption
Fig. 2 shows the evaluation of Erms for different time instances. Initially, it assumed that all nodes consumed zero Fig. 2. Erms for different time instances. From the results, it concludes that the MIP model has reached at the top position as compared to both the proposed model and LAM model in terms of Erms. As on time increases the energy consumption of all nodes will increase due to mobility. Then it system requires more number of route discoveries to perform well. Consequently, it takes high energy consumption over the network.

Fig. 4. Erms for different time instances

V. CONCLUSION

The algorithm efficiently utilizes the battery power of the mobile nodes in such a way that it will improve the network energy consumption and increase the lifetime of the network and This algorithm does not always choose only the shortest path between source and destination but choose such routing path that nodes have the maximum residual energy as well as shortest path.

This algorithm not only considers energy of the node while selecting the route but also takes into account the number of packets buffered in the node. More number of buffered packets means remaining energy will be less and time taken to deliver a packet will be more. This proposed algorithm is differed from existing algorithms.

The simulation results reported in this paper demonstrate that the proposed model improved the network lifetime by 20% on average. Extending network lifetime is accomplished by finding multicast that tends to minimize the variation of remaining energy of all the nodes.

REFERENCES


