Energy Efficient Routing Protocol with Selection of Cluster Head for Mobile Ad Hoc Network

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ABSTRACT
Mobile ad hoc network is composed of nodes which are connected wirelessly. There is no definite topology as the mobile nodes keep moving from one position to another. The nodes in MANET are battery operated so the efficient power aware routing protocol is introduced to maintain the battery life as well as the network lifetime which is been affected by battery of the nodes. The proposed algorithm maximizes the network and battery lifetime by selecting the best node every time as cluster head in the network as well as taking mobility of cluster head into consideration and activating less number of users.

Keywords
Mobile ad hoc network, Power aware routing, Cluster head

INTRODUCTION
Mobile Ad hoc networks are infrastructure less network with multi hop communication scheme and without any centralized access point. Due which the mobile ad hoc network have dynamic topology. When the nodes are in its radio direct transmission of data will take place. If the nodes are not in the radio range then the transmission takes place through multi hops i.e., the sender node sends its data to the destination node through the intermediate node. The mobile nodes in the MANET dynamically establish routes among themselves to form their own network in an ad hoc fashion so that the users can move anywhere and at anytime. In MANET’s the most important is the battery resource in the nodes which will help in maintaining the network lifetime. Hence power routing protocols has been established to maintain the battery life of the nodes which will in turn maintain the network lifetime. The routing protocols are broadly classified into three types: proactive, reactive and hybrid. In proactive the nodes will store the information of all the neighboring nodes. As the nodes move from one position to another then continuously exchange of the information about the topological changes is been updated in each node. Though it will take less time to find the path to transmit data but the disadvantage is to maintaining the information of all the nodes where as in case of reactive protocol the information of the node is obtained as and when needed. This type of protocol will give more lifetime to battery as it does not have to store and update information of the nodes whenever the topology changes.

LITERATURE SURVEY
Power aware localized routing protocol works on the basis that each node will have information of the other node present in the network. Storing this information will lead to find an efficient path. The main disadvantage of this method is overhead of storing information about every other node leading to consumption of the battery power of the nodes. In [1] Minimum total transmission power routing it selects the path that consumes minimum power but on the cost of activating many nodes. Thus the disadvantage is activation of many intermediate nodes which will decrease the lifetime of network. In [2] Cluster head selection power
aware routing method the information was send from source to the destination if the nodes are in the radio range and if the source and destination are not in the range the information is transferred to the cluster head to further pass it to either destination or gateway. The disadvantage of this method is every time it has to send its data to the cluster head and the paper does not give a description about selection of cluster head.

PROPOSED METHODOLOGY

The proposed protocol is aimed at reducing the number of nodes when forwarding the packets of data from source to destination and it will help increasing the network lifetime by applying the protocol in such a way that it will consume less power in transmitting the packets of information. MANET consists of dynamic topology of the nodes in the network. Hence the nodes are first divided into clusters and each cluster will have a cluster head. The cluster head selection is done based on 3 factors they are minimum mobility, maximum energy and minimum density.

The algorithm works as follows. Once the cluster is formed the head selection is done by taking 3 factors into consideration i.e., minimum mobility, maximum energy and minimum density. The Cluster head is selected among the node by taking the above three factors. By comparing these factors with other nodes, the node which will satisfy most of the feature then that node is selected to be as Cluster head. If some nodes are satisfying two properties like one node is having minimum mobility and maximum energy and other node is satisfying maximum energy and minimum density then the head selection is done based on remaining factor which is not satisfied by the node.

If the source and the destination are present in the radio range then the source will directly transmit the data packets to the destination without any intermediate node. If source and destination are not directly reachable then with the help of intermediate node the information packets are transferred. The intermediate node can be a gateway or the cluster head depending upon the distance between the nodes.

Now initially when the source and destination are not in range then the information is either transferred to cluster head or gateway node. Let us consider the information is transferred to cluster head. There are 2 possibilities the destination can be in range of cluster head or away from cluster head. In the first possibility the cluster head will send the information to the destination directly and in the second possibility the cluster head sends the information to cluster head or to gateway node. It checks if the next cluster head is taking less power or the gateway node is taking less power. Depending upon the power consumption for transmitting the data packets the cluster head will send the information to the respective node which will consume less power.

Let’s consider the packets of information is at the gateway node again at the gateway node it has 2 possibilities the first possibility is the destination is directly reachable and in the second possibility it has to used intermediate nodes to reach the destination. The gateway node will check if the destination is directly reachable it sends the data to the destination when it is not reachable then it sends to cluster head or to the gateway node depending on the power consumed by the respective node.

The parameters considered for analysis is the number of nodes and energy consumed by the nodes. Energy is defined as the power derived from the node during a particular time. It is defined as the product of Power and time. The energy consumption of a node is given by the below formula

\[
\text{Energy Consumption} = (\text{Distance of transmission}) \times (\text{Per bit energy needed})
\]

SIMULATION WORK

The simulation work is carried out in NS2. There is a source node, gateway node, cluster head and destination node. Each node is given a unique number. The clusters are divided and are assigned with different colors. Among the nodes in the cluster a particular node is selected as the cluster head. Figure 1 shows a sample of ad hoc network with 2 clusters having 9 nodes. So in this method we have considered the number of nodes to 33 which are divided in four clusters and the destination is assumed to be static.
Figure 1: A sample of ad hoc network

The Cluster head is represented by represented by blue color and is denoted as CH, gateway node is represented by orange color and is denoted by GN, the normal node is represented by green color and is denoted by NN and the destination node which is the base station is always going to be static is represented by purple color and is denoted by BS. For each cluster there is one respective cluster head available which will have the centralized control over all the information sent from one cluster to another cluster. The normal node will forward the data packets to their respective cluster head and the cluster head will transfer the packets of information from one cell to another cell through gateway node. If there is two or more gateway node available in one particular cluster then this algorithm will select the best gateway node among all and then sends the packet of information. The gate way nodes are preferred in such a way that the information to the destination is reached successfully.

RESULTS

The analysis is done based on two parameters they are number of nodes getting activated during the transaction of data packets from source to destination and the other parameter is energy consumption during the different rounds. The number of active node are compared with the proposed algorithm which is represented as Efficient Cluster head (ECH), Power efficient cluster head routing protocol (PECHR) and Efficient power aware routing protocol for cluster head (EPARCH). The number of nodes activated is shown in Table 1 and is represented in figure 2.

<table>
<thead>
<tr>
<th>Methods</th>
<th>Number of active nodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>PECHR</td>
<td>28</td>
</tr>
<tr>
<td>EPARCH</td>
<td>9</td>
</tr>
<tr>
<td>ECH</td>
<td>5</td>
</tr>
</tbody>
</table>

Figure 2: Number of active users with different protocols
The second parameter considered for comparison is the energy consumption with different mobility. The second parameter is compared between two protocols which are Dynamic source routing (DSR) and Ad Hoc On-Demand Distance Vector protocol (AODV). The initial energy of the node is assumed to be 100 Joules. The table 2 shows the energy consumed by nodes with different mobility. The figure 3 shows the respective parameters. As we can see in the figure with less mobility both the protocol DSR and AODV goes hand in hand there is not much difference in the energy consumption but as the mobility increases there is a difference in the energy consumption parameter. As we can see in the figure DSR will consume less power when compared with the AODV protocol when the mobility is increased.

<table>
<thead>
<tr>
<th>Mobility(m/s)</th>
<th>AODV (Joules)</th>
<th>DSR (Joules)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>98.30</td>
<td>99.191</td>
</tr>
<tr>
<td>20</td>
<td>96.11</td>
<td>95.121</td>
</tr>
<tr>
<td>30</td>
<td>88.561</td>
<td>87.561</td>
</tr>
<tr>
<td>40</td>
<td>83.2</td>
<td>85.231</td>
</tr>
<tr>
<td>50</td>
<td>75.54</td>
<td>80.54</td>
</tr>
</tbody>
</table>

Figure 3: Energy consumption with different protocols

CONCLUSION AND FUTURE SCOPE

The proposed methodology aimed at saving the battery and proportionately increasing the network lifetime by reducing the consumption of energy in transferring packet from a source node to destination node in MANET. With the figure 2 we can see that the energy required by nodes in the proposed methodology is much more efficient as it activates less number of nodes which will indirectly consumes very less power for a single transaction. As the proposed algorithm reduces the number of active users which can be seen in figure 2 hence battery lifetime is maintained and proportionately the network lifetime is also increased. The proposed algorithm also concludes about the energy consumption with mobility. If the mobility is less this algorithm will work similar for both DSR and AODV but as the mobility is increased is DSR protocol will consume less energy.
power. In the future the network can be testing with hundreds and thousands of nodes and can be compared with other protocols and parameters depending upon the application.

REFERENCES