Abstract

A Wireless network is a collection of wireless nodes which collectively form a network among themselves without need of any infrastructure. The energy consumption is one of the research issues in such kind of networks. Therefore efficient design of routing protocol is required which saves energy in wireless networks. There are lot of work has been discussed regarding energy efficiency in routing protocols for ad hoc networks. In this research paper, an Efficient Energy Robust (EER) mechanism is proposed to decrease the energy consumption and increase the lifetime of wireless ad hoc networks. This mechanism uses the caching of RREQ and RSEND packets and keeps more than one route in routing table for each destination. This mechanism uses short control message (low overhead) and faster routing mechanism. This method would enhance the route selection procedure of routing protocols. It initiates the link lifetime and node’s residual energy to enhance the route discovery.
process that permits the routes that assures the link lifetime and energy requirements. EER mechanism would be compared with AODV, DSR, DSDV and OLSR protocols to check out efficient working of proposed method. The network simulator 2 (version 2.35) is used to analyze the performance of routing protocols. The simulation results showed that all routing protocols perform quite similar for all scenarios. The EER mechanism is compared with all protocols and showed 4.03 % improvement in case of number of connections, 3.63 % improvement in case of number of nodes, 4.73 % improvement in case of pause time, 0.72 % improvement in case of source sending rate, 9.16 % improvement in case of speed scenario when compared with DSR protocol.

I. INTRODUCTION

Energy consumption in mobile devices is commonly recognized as an important issue for further research by the research community. In Wireless networks, every node in the ad hoc network forwards packets for other nodes, to allow nodes to communicate are those not in direct wireless transmission range and act as intermediate node. All the mobile node are able to function as both a router and a terminal node which is a source or destination, thus the failure of some nodes operation can greatly obstruct the performance of the network and also affect the basic ease of access to the network. Since the nodes in wireless networks have limited battery power, so it is essential to competently use energy of every node in such networks. A reliable routing protocol for such networks preserves the energy consumption as low as possible. In this type of networks, energy parameter acts an important role in the research. The network interface hardware at a node can operate in four different modes:

1. Transmit mode: The mode at a node when transmitting a packet.
2. Receive mode: The mode at a node when receiving a packet.
3. Idle mode: The mode used at a node when the node is neither transmitting nor receiving a packet. This mode utilize power because the node is in listening state in wireless medium continuously to detect a packet that it should receive, so that the node can change their mode into receive mode.
4. Sleep mode: Sleep mode has very low power consumption than idle mode. The network interface at a node in sleep mode can neither transmit nor receive packets even node not in listening state; the network interface must be woken up to idle mode first by an explicit instruction from the node.

The routing protocol DSDV [1] considered for energy consumption analysis and found that it experiences large amounts of overhead to the network owing to the requirement of the regular update messages, and the overhead grows at the quantity of O(N^2). Also the routing protocol DSR [2] is analyzed regarding energy consumption and found that it uses broadcast for route finding while broadcast causes surplus message forwarding traffic and energy consumption, especially when the network is large. The routing protocol AODV [3] is analyzed for energy consumption...
and found that it uses the route discovery and route maintenance exercise of DSR. DSR packet carries the entire route information, while the packet of AODV only carries the destination address, it has less routing overhead than DSR. At the same time, AODV uses routing messages and sequence numbering.

AODV protocol is a reactive routing protocol which discover route to destination when required. AODV consists of routing table which assists to differentiate between expiry and fresh routes. The routing table at node encloses the sequence number and next hop information. The working of protocol is consists of two phases:

1. Route discovery and
2. Route maintenance.

In route discovery process, the source node generate RREQ packet, if the path to destination is not stored in the routing table, and get ahead of it to the neighbouring nodes. The neighbouring nodes will bypass it to their neighbour and so on. When the packet disembark at to the destination node, then destination node generate RREP (Route Reply) packet and send it back to the source node. Thus the path is created between source and destination node. In route maintenance procedure, the source node is up to date by RERR (Route Error) message in case of link failure. Also the connectivity between the nodes is continuation using Hello messages. There are two main factors that cause link failures are:

1. Battery life time
2. Mobility

The Energy -Control come up to is permitting nodes to decide the least amount of transmission power level which is sufficient to preserve network connectivity and to bypass the traffic with less energy, the objectives is to increase network capacity and declining energy consumption. The Energy -Save come up to deal with the power loss through the idle mode and this can be minimized by increasing the amount of time a node spends in the sleep mode. Finally, the Maximum-Lifetime routing come up to emerge for the nodes that have minimum energy so that they can be removed from the path.

The paper is organized as follows. Section II survey the related work to estimation of energy based Ad hoc routing protocols for MANET. Section III describes the problem identification. Section IV introduces the proposed methodology about energy robust mechanism. Section V describes the simulation results obtained using network simulator 2.35. Section VI describes the conclusion and future work of the paper.

II. RELATED WORK

There are diverse existing methods for assessment of network lifetime in wireless networks. Some routing algorithms use the link lifetime as well as the nodes battery life time as routing metrics to allow the most consistent and energy efficient route to be selected for data transmission. Feeney [5] shows the requirement and actual measured current represented by one popular wireless network interface card in the
four possible modes. Receive and idle mode require same power, and transmit mode requires a little greater power. Sleep mode requires less power than idle mode. These measurements reveal that the network interface uses up similar energy, in case if it is simply listening or receiving data. Hence, cleverly switching to sleep mode whenever possible will significantly increase energy savings. The full version of these protocols is available from the thesis [6]. Zorzi and Rao [7]-[8] represented a routing protocol in which every node pursues the duty cycle about wake up and sleep modes.

Minimum Battery Cost Routing (MBCR) has been proposed in [9]. MBCR routing protocol calculates the sum of the continuing power of all nodes in a path and uses it for choosing a path, but the method may decide a path in which there may present mobile nodes with less power. Thus, these low power mobile nodes may affect path breakage.

Syropoulos et al [10], have proposed the use of Directional Antennas for energy efficient communication in ad hoc networks.

Jin-Man Kim et al., [11] introduced an Energy Mean Value algorithm to increase AODV routing protocol and to improve the network lifetime of MANET.

Krishna Cheong Lau and Joseph H. Kang [12] made proposal to increase energy efficiency, nodes in the network walk off into a sleep mode and wake up at preset time slot(s) to snoop for transmissions from its instant neighbours. The knowledge of awakening slots for neighbouring nodes is used to arrange the transmissions within the neighbourhood. Lastly, nodes adjust their sleeping cycles based on neighbour topology and residual battery life in order to maximize the network lifetime also satisfying the latency requirements of sensor applications.

### III. PROBLEM IDENTIFICATION

The previous research presented a comparison of energy consumption of reactive protocols (AODV, DSR) and proactive routing protocols (DSDV and OLSR). In high mobility and traffic load reactive protocols are more energy efficient than proactive routing protocols. For most of the cases DSR and AODV routing protocols are more effective in energy consumption than DSDV and OLSR protocols because they use source routing without using any periodic retransmission. The main problem identified is that the type of routing protocols affects the significantly the energy consumption due to different routing overhead used for sending and receiving the routing packets. So, there is a requirement in routing protocols to enhance their energy consumption and reduce energy consumed in the network. Overall, there is a need to decrease the energy consumption and increase the lifetime of the network.

Objective of proposed Research: An Energy Efficient Robust (EER) mechanism is proposed to decrease the energy consumption and increase the lifetime of Mobile Ad Hoc Networks (MANETs). This mechanism uses the caching of RREQ and RSEND packets and keeps more than one route in routing table for each destination. This mechanism uses short control message (low overhead) and faster routing mechanism. This method would enhance the route selection procedure of routing protocols. It initiates the link lifetime and node’s residual energy to augment the route discovery process that allows the routes
that assures the link lifetime and energy requirements. The proposed system utilizes the node energy when it reaches the minimum power level called MIN_Threshold. When the node reaches the MIN_Threshold level it goes into sleep mode after performing following functions: If the energy of the neighbour node is greater than 50, then cache updating is performed on the node and new route is established through that node. Otherwise, the node with maximum energy is chosen for cache updating then a new route is established. EER mechanism would be compared with AODV, DSR, DSDV and OLSR protocols to check out efficient working of proposed method.

IV. PROPOSED METHODOLOGY

Figure 1 shows the flowchart of EER methodology. To An Energy Efficient Robust (EER) mechanism is proposed to decrease the energy consumption and increase the lifetime of Mobile Ad Hoc Networks (MANETs). This mechanism uses the caching of RREQ and RSEND packets and keeps more than one route in routing table for each destination. The EER mechanism first estimates the nodes density of the network and calculates their energy levels. Whenever a source node want to communicate with the destination node, it check the energy level of neighbour nodes, if the energy level is found to be more than 50 joules, it selects those neighbouring nodes and update the routing table. The proposed system utilizes the node energy when it reaches the minimum...
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Increasing Network Lifetime using Energy Efficient Robust Mechanism for Wireless Ad hoc Networks

power level called MIN_Threshold. When the node reaches the MIN_Threshold level it goes into sleep mode after performing following functions:
i. If the energy of the neighbour node is greater than 50, then cache updating is performed on the node and new route is established through that node.
ii. Otherwise, the node with maximum energy is chosen for cache updating then a new route is established

Whenever a neighbour node energy level is found to be less than 50 joules, it skips the source node to send the data and stop communication among them. Otherwise, the source node seek the routing table, and select those neighbouring nodes which has highest energy level and start sending data towards destination node.

This mechanism uses short control message (low overhead) and faster routing mechanism. This method would enhance the route selection procedure of routing protocols. It initiates the link lifetime and node’s residual energy to augment the route discovery process that allows the routes that assures the link lifetime and energy requirements.

EER mechanism would be compared with AODV, DSR, DSDV and OLSR protocols to check out efficient working of proposed method. The parameters for routing protocol performance considered are:
i. Energy Consumption vs no. of nodes.
ii. Energy Consumption vs no. of connections.
iii. Energy Consumption vs source sending rate.
iv. Energy Consumption vs speed.
v. Energy Consumption vs pause time.

V. SIMULATION RESULTS AND GRAPHS

The Efficient Energy Robust (EER) mechanism is implemented in network simulator 2. The average energy consumption of EER mechanism along with AODV, DSDV, DSR and OLSR protocols has been studied. This chapter presents the simulation result obtained according to varying number of nodes, no of connections, speed, source sending rate and pause time.

Average Energy Consumption is the total energy consumption of mobile nodes divided by total number of nodes, the equation is given by:

\[ \text{Average Energy Consumption} = \frac{\sum_{1}^{n} \text{Total Energy Consumed}}{\text{Total number of Nodes}} \]

The following table 1 shows the simulating parameters set up before experiment.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Energy</td>
<td>100</td>
</tr>
<tr>
<td>Idle Power</td>
<td>712e-6</td>
</tr>
<tr>
<td>Receiving Power</td>
<td>0.3</td>
</tr>
<tr>
<td>Transmission Power</td>
<td>0.6</td>
</tr>
<tr>
<td>Sleep Power</td>
<td>144e-9</td>
</tr>
</tbody>
</table>
Figure 2: Number of Connections

The figure 2 represents the average energy consumption of routing protocols according to number of connections 5, 10, 15, 20 and 25. The number of connections is set according to source destination pairs moving arbitrarily in any direction of mobile ad hoc networks. The above graph shows that average energy consumption of AODV protocol is higher compare to other protocols. The average energy consumption of OLSR and DSDV protocols are quite similar for all number of connections. Also DSR protocol and EER mechanism showed nearly the same performance but the energy consumption rate for EER mechanism is quite less than DSR protocol. The EER protocol showed 4.03 percent improvement than DSR protocol.

Figure 3: Number of Connections

The figure 3 represents the average energy consumption of routing protocols according to number of nodes 5, 10, 15, 20 and 25. The number of nodes is set according to source destination pairs moving arbitrarily in any direction of mobile ad hoc networks. The average energy consumption of AODV, OLSR and DSDV protocols are quite similar for
all number of nodes. Also DSR protocol and EER mechanism showed nearly the same performance but the energy consumption rate for EER mechanism is quite less than DSR protocol. The EER protocol showed $3.63\%$ improvement than DSR protocol.

The figure 4 represents the average energy consumption of routing protocols according to pause time 0, 40, 80, 120 and 160. The pause time is set according to source destination pairs moving arbitrarily in any direction of mobile ad hoc networks. The average energy consumption of AODV, OLSR and DSDV protocols are quite similar for all pause time scenarios. Also DSR protocol and EER mechanism showed nearly the same performance but the energy consumption rate for EER mechanism is quite less than DSR protocol. The EER protocol showed $4.73\%$ improvement than DSR protocol.

![Figure 4: Pause Time](image)

The figure 5 represents the average energy consumption of routing protocols according to source sending rate 1, 2, 3, 4 and 5. The source sending rate is set according to source destination pairs moving arbitrarily in any direction of mobile ad hoc networks. The average energy consumption of AODV, OLSR and DSDV protocols are quite similar for all source sending rate scenarios. Also DSR protocol and EER mechanism showed nearly the same performance but the energy consumption rate for EER mechanism is quite less than DSR protocol. The EER protocol showed $0.73\%$ improvement than DSR protocol.

![Figure 5: Source Sending Rate](image)
The figure 6 represents the average energy consumption of routing protocols according to speed 0, 5, 10, 15, 20 and 25. The source sending rate is set according to source destination pairs moving arbitrarily in any direction of mobile ad hoc networks. The average energy consumption of AODV, OLSR and DSDV protocols are quite similar for all speed scenarios since nodes are moving in arbitrarily in any direction with varying speed. Also DSR protocol and EER mechanism showed nearly the same performance but the energy consumption rate for EER mechanism is quite less than DSR protocol. The EER protocol showed 9.16 percent improvement than DSR protocol.

![Figure 6: According to speed](image)

VI. CONCLUSION AND FUTURE WORK

After In this experiment, Routing protocols performance regarding their energy consumption is discussed for Mobile Ad Hoc Networks (MANETs). The aspect of energy consumption is discussed because this is one of the most crucial design concerns in MANETs as mobile nodes have limited battery. The performance evaluation of four routing protocols have been discussed namely AODV, DSR, DSDV and OLSR protocols. Different mobility and traffic models are used to study their energy consumption. The energy parameter is considered against number of nodes, number of connection, source sending rate, speed and pause time.

In a proposed work, an Energy Efficient Robust (EER) mechanism is proposed to decrease the energy consumption and increase the lifetime of Mobile Ad Hoc Networks (MANETs). This mechanism uses the caching of RREQ and RSEND packets and keeps more than one route in routing table for each destination. This mechanism uses short control message (low overhead) and faster routing mechanism. This method would enhance the route selection procedure of routing protocols. It initiates the link lifetime and node’s residual energy to augment the route discovery process that allows the routes that assures the link lifetime and energy requirements. The proposed system utilizes the node energy when it reaches the minimum power level called MIN_Threshold. When the...
node reaches the MIN_Threshold level it goes into sleep mode after performing following functions:

i. If the energy of the neighbor node is greater than 50, then cache updating is performed on the node and new route is established through that node.

ii. Otherwise, the node with maximum energy is chosen for cache updating then a new route is established.

The simulation results showed that all routing protocols perform quite similar for all scenarios. The EER mechanism is compared with all protocols and showed 4.03% improvement in case of number of connections, 3.63% improvement in case of number of nodes, 4.73% improvement in case of pause time, 0.72% improvement in case of source sending rate, 9.16% improvement in case of speed scenario when compared with DSR protocol.

Following table 2 shows the simulative results between EER mechanism and DSR protocol with percentage improvement.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>DSR (Average)</th>
<th>EER (average)</th>
<th>Improvement (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Connection</td>
<td>5480.87</td>
<td>5259.84</td>
<td>4.03</td>
</tr>
<tr>
<td>Number of Nodes</td>
<td>7500.5</td>
<td>7228.38</td>
<td>3.63</td>
</tr>
<tr>
<td>Pause Time</td>
<td>12938.55</td>
<td>12326.63</td>
<td>4.73</td>
</tr>
<tr>
<td>Source Sending Rate</td>
<td>3335.9</td>
<td>3311.64</td>
<td>0.72</td>
</tr>
<tr>
<td>Speed</td>
<td>18826.26</td>
<td>17095.69</td>
<td>9.16</td>
</tr>
</tbody>
</table>

In a future work, Efficient Energy Robust (EER) mechanism would be enhanced to decrease energy consumption and increasing lifetime of the network with more number of nodes.

VII. REFERENCES


PAPER CITATION