CHAPTER 6

LIFETIME MAXIMIZATION TECHNIQUE USING LIGHT WEIGHT MEMORY
SHARING SCHEME OF NANOMACHINES FOR DATA TRANSMISSION IN MANET

6.1 INTRODUCTION

In mobile ad hoc network the mobile nodes move between base stations and will switch between base stations dynamically. The base station node will be a fixed one and mobile station node will be moving. The mobile node can communicate with the base station only if it is present within the range of the base station. Each node whether it is base station or mobile station has its own range of communication. Each node has fixed power and each communication made by the base station or mobile node consumes some power. The power consumption caused by the communication highly affects the life of the base station and mobile station. Another constraint is routing, the process of transferring data packets between the source and the destination through a set of mobile nodes. There are various techniques that have been discussed in earlier chapters, for the routing of data packets in mobile ad hoc networks based on nano technology.

Nanomachines are tiny nodes, which have limited memory capacity and can store information in limited quantity. The nano nodes are mobile nodes which can move between stations and has little memory storage. In this case, the nanomachines share memory between them by storing the route details in all the nodes, and share the complete as well as recent route details between the single neighbours. The most energy consuming process in the nano machine is route discovery. The nanomachines discover the routes between the source and the destination, by sending request and reply messages. It needs a number of broadcasts and a
number of replies to be received in this. This makes the node to lose most of the energy in this phase. To avoid this, the memory sharing schemes can be used to reduce the energy depletion, occurring in the neighbouring nodes.

The quality of service in mobile ad hoc network has improved, where the service has to be provided for a long period of time. The quality of service is not only based on energy, but also on the memory constraints. Here, considering both, to improve the quality of service of the overall network, the energy loss has to be reduced by reducing the frequency of route discovery to increase the quality of service and life time of the network.

6.2 PROPOSED WORK

The dynamically changing topological nature of mobile ad hoc network needs frequent route computation between the source and the destination. The problem of memory constraints in MANET had been studied extensively earlier but it suffers from memory shortage, where the nodes have to keep track of information about the topology and neighbour details to perform route computation. A new proposal of memory sharing scheme between nanomachines has been proposed in order to improve the quality of service. The selected route for data transmission from the source to the destination is shared between nodes to reduce the overall latency and to increase the throughput of the network. In the proposed approach, the source node broadcasts the route request called Nano Route Request (NRREQ). On receiving this request, the neighbour node verifies its route table for an entry to the destination node. If the entry is present, then the source node will receive the Nano Route Reply (NRREP) otherwise, it rebroadcasts the route request to other neighbouring nodes, and the process gets repeated. Whenever an intermediate node receives an acknowledgement, it updates the route table and shares the same with its neighbours and sends the reply towards the source. This proposed approach decreases the frequency of route computation and increases the throughput.
of the overall network. The proposed work is about Light Weight Memory Sharing (LWMS) scheme that includes neighbour discovery, route discovery, short memory sharing and packet forwarding as its important functional components as represented in figure 6.1.

![Figure 6.1 Proposed System Architecture](image)

The proposed method has four stages of data transmission namely: Neighbour Discovery- where the nanomachine discovers geographic neighbour nodes of its own within the coverage of its data transmission. Route Discovery-Performs discovery of available route to reach a destination on demand. Memory Sharing- shares the discovered routes to all its neighbours and finally to the packet forwarding phase of the protocol.
6.2.1 Neighbour Discovery

A hello message is constructed and broadcasted by the source node to all its neighbouring nodes. The neighbour nodes, which are closer and within the coverage of the source node, will reply to that. On receiving the reply, the source node updates its neighbour table with the node id of the node replied. Only for a certain time the source node can receive the reply. The Hello message will be broadcasted to only one hop and the protocol collects one hop neighbour only. The figure 6.2 shows the flow chart of the neighbour discovery phase in detail.

Figure 6.2 Flow Chart of Neighbour Discovery Phase
The procedure to find the neighbour nodes is as follows:

**Step 1:** Initialize Neighbour table Nt to Null. and LWMSB Timer

**Step 2:** Construct Hello Message HM = {Node Id, Packet ID, Packet Type}

**Step 3:** Broadcast Packet HM.

**Step 4:** Start LWMSB Timer

While Timer ON

Receive Hello Reply HREP

NodeId\_i = HREP (Node.Id).

$$Nt = \Sigma NodeId + NodeId_i$$

End

**Step 5:** Stop

The above procedure shows the detailed stages of neighbour discovery and updates the neighbour table which will be used in route discovery phase.

### 6.2.2 Route Discovery

In the route discovery phase, the source node intended to transmit a packet towards a destination which does not have a direct route or some other route in its route table. It constructs a Light Weight Memory Sharing Scheme Route Request (LWMSSRREQ) packet, and broadcast into the network which will be further rebroadcasted into the network of multi hop neighbours. The neighbour node which receives the LWMSRREQ packet will look up at the route table and neighbour table for the entry about the node id requested. If an entry is
found, the node constructs a Light Weight Memory Sharing Scheme Route Reply (LWMSSRREP) packet and sends in the reverse direction towards the source node. Otherwise the node adds the address of its own and rebroadcast the packet to other neighbours. Finally, when the source node receives the LWMSRREP packet, it will extract the hop addresses from the reply packet and update its routing table. The figure 6.3 shows the flow chart of route discovery phase.

![Figure 6.3 Flow Chart of Route Discovery Phase](image-url)
The procedure for route discovery is as follows:

**Step 1:** Read route table RT.

**Step 2:** Construct LWMSRREQ packet with the destination and source address.

\[ \text{LWMSRREQ} = \{\text{Packet Id, Node Id, Destination ID, TTL}\} \]

**Step 3:** Broadcast LWMSRREQ packet into the network

**Step 4:** Receive LWMSRREQ

\[ \text{if } j^N \text{ RT } \notin \text{LWMSRREQ(DestId)} \text{ then} \]

construct LWMSRREP packet = \{Node Id, Destination Id, Hop Id\}

else

Rebroadcast LWMSRREQ to other neighbours

End.

**Step 5:** Stop

6.2.3 Short Memory Sharing Scheme

Whenever a nanonode receives the route reply and has a valid route to reach the destination, routing information will be shared between the nanonodes. The node which receives the new route constructs the route update packet, which specifies a valid available route to reach some destination far from here and sends it to its, two neighbour hops. All the nodes which receive this packet extracts the route information from the packet and verifies with the available routes in the route matrix and checks for the shortest path. If it is the
shortest path, the route will be updated to get more valuable route to reach the destination. The figure 6.4 shows the flow chart of the short memory sharing scheme.

![Figure 6.4 Flow Chart of Short Memory Sharing Scheme](image)

The procedure for short memory sharing scheme is as follows:

**Input:** LWMSRREP packet

**Output:** Updated Route matrix RT.

**Step 1:** Extract Routes available \( RA = \sum_{i=1}^{N} Routes(LWMSRREP)RT \)

**Step 2:** Construct LWMSRU packet
LWMSRU = \{\text{Nodeid, RA}\}.

**Step 3:** Broadcast packet to neighbours.

**Step 4:** Receive LWMSRU packet

Extract Routes available \( RA = \sum_{i=1}^{N} Routes(LWMSRU) \triangleright RT \)

**Step 5:** Update route table RT.

\( RT = \sum Routes(RT) + Routes(RA) \)

**Step 6:** Stop.

### 6.2.4 Packet Forwarding

The packets are forwarded towards destination using the route selected. The source node identifies the shortest route from the route table and selects the most efficient route according to energy constraints. The packet will be forwarded to the selected node towards the destination. The intermediate node which does not have any route, will perform route discovery phase and updates its own and other route table before forwarding the packet to the destination.

### 6.3 EXPERIMENTAL SETUP

The proposed method has been implemented in Network Simulator with version 2, and the protocol has been evaluated with various simulation parameters as shown in table 6.1 below. The simulations were carried out using a MANET environment consisting of 80 wireless mobile nodes roaming over a simulation area of 1200 meters x 1200 meters flat space operating for 10 seconds of simulation time. The radio and IEEE 802.11 MAC layer models were used. Nodes in our simulation move according to Random Waypoint mobility model,
which is in random direction with maximum speed from 0 m/s to 20 m/s. A free space
propagation channel is assumed for the simulation. Hence, the simulation experiments do not
account for the overhead produced when a member leaves a group. Each mobile node in the
network starts its journey from a random location to a random destination with a randomly
chosen speed. This analysis is based on CBR traffic model. The table 6.1 shows the simulation
parameters used to evaluate the proposed method.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulator</td>
<td>Ns-2</td>
</tr>
<tr>
<td>Routing Protocols</td>
<td>DSR, AODV, LWMS</td>
</tr>
<tr>
<td>Propagation Model</td>
<td>Two Ray Ground</td>
</tr>
<tr>
<td>Number of Nodes</td>
<td>10 to 80</td>
</tr>
<tr>
<td>MAC Layer</td>
<td>IEEE 802.11</td>
</tr>
<tr>
<td>Simulation Time</td>
<td>10 to 60 sec</td>
</tr>
<tr>
<td>Average Forwarding Delay</td>
<td>1ms</td>
</tr>
<tr>
<td>Simulation Area</td>
<td>1200*1200m</td>
</tr>
<tr>
<td>Transmission Range</td>
<td>50-300m</td>
</tr>
<tr>
<td>Node Movement Model</td>
<td>Random Way Point</td>
</tr>
<tr>
<td>Traffic model</td>
<td>CBR(UDP)</td>
</tr>
<tr>
<td>Transfer per Packet</td>
<td>512 Bytes</td>
</tr>
</tbody>
</table>

Table 6.1 LWMS Simulation Configuration Settings

6.4 PERFORMANCE EVALUATION

The most important performance metrics of LWMSS routing protocol are throughput,
average delay and packet delivery ratio. The main objective of this work is to compare the
proposed LWMSS routing performance with DSR and AODV protocols. The simulation
results are given in table 6.2.
### Table 6.2 Qos Comparison of Different Protocols

<table>
<thead>
<tr>
<th>S.No</th>
<th>No. of Nodes</th>
<th>Protocol</th>
<th>Throughput (kbps)</th>
<th>Average Delay (sec)</th>
<th>PDF (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50</td>
<td>DSR</td>
<td>43</td>
<td>21</td>
<td>81.23</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>AODV</td>
<td>50</td>
<td>18</td>
<td>86.70</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
<td>LWMS</td>
<td>86</td>
<td>6</td>
<td>94.60</td>
</tr>
</tbody>
</table>

#### 6.4.1 Throughput Performance

Figure 6.5 shows the overall throughput performance of different protocols and it is clear that the proposed LWMS method has achieved higher throughput than other protocols.

![Figure 6.5 Throughput Comparison](image)

#### 6.4.2 Packet Delivery Ratio

The ratio of total packets received by the destination to total packets sent. This illustrates the level of delivered data to the destination. Figure 6.5 shows the performance of packet delivery ratio of different protocols and it shows that the proposed LWMS method has higher packet delivery ratio than other methods.
6.4.3 Average Delay

Figure 6.7 shows the latency ratio of different protocols and it shows clearly that the proposed LWMS method has lower latency ratio than others.
6.5 SUMMARY

The proposed light weight memory sharing scheme has been tested and evaluated for its performance in various simulation parameters. The proposed scheme discovers the available routes to reach the destination and shares the route memory between other neighbours of the network by two hop method. This overrides and avoids the unnecessary broadcasting of route discovery phase and reduces the frequency of route discovery. The proposed approach reduces the network overhead which arises through route discovery also. The performance and lifetime of the overall network have been improved using the proposed approach.