# Improving Performance in Ad hoc Networks through Location based Multi Hop Forwarding

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**Abstract**

Location-based Multi Hop Forwarding (LMHF) is a state-free forwarding technique. In this paper, we develop a general analytical framework to evaluate the performance of LMHF in an ad hoc network. In this technique, a reliable multi hop route is selected for successful data transmission. To efficiently deliver data, the proposed method first employs the next node forwarding step which decides whether to transmit the data directly or through multiple hops. In the next step, the multiple hops use the location information of its own forwarding nodes to efficiently deliver packets to the destination. Location information's are periodically updated by all the intermediate forwarding nodes in the forwarders list. The simulation experiments showed that the proposed method can achieve efficient data delivery under various network strategies.

**Keywords:** Reliable, Location, Delivery, Forwarding, Multi Hop

## 1. Introduction

A mobile ad hoc network is an autonomous system of infrastructure-less, multi-hop, wireless mobile nodes. An ad hoc network typically refers to any set of networks where all devices have equal status on a network and are free to associate with any other ad hoc network device in link range. Ad hoc network often refers to a mode of operation of IEEE 802.11 wireless networks. Due to its potential applications in various situations wireless ad hoc networks [1]–[4] have recently emerged as a premier study. In an ad hoc network, a message sent by a node reaches all its neighbouring nodes that are located at distances up to the transmission radius. Because of the limited transmission radius, the routes between nodes are normally created through several hops in such multi-hop wireless networks. It is difficult for a MANET to make reliable communication among moving nodes due to the instability of the network topology and the wireless network condition.

The task of finding and maintaining routes in ad- hoc networks is nontrivial because as the host mobility changes the topological also changes. The problem of location update schemes is more difficult than routing. To improve data delivery over an unstable wireless network, [5] proposed opportunistic routing, which uses packet distribution via wireless broadcast. The routing task is considered to deliver data reliably from a source node to a destination node in a wireless network. In this paper, Location based Multi Hop Forwarding LMHF scheme has been proposed to reliably select the forwarding nodes in the transmission path for secure and low overhead data transmission.



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The paper proceeds as follows. Section 2 describes related research works. Section 3 explains the operation of the proposed Location based Multi Hop Forwarding Scheme. Section 4 presents the simulations conducted in order to evaluate the proposed work and summarizes the result. Finally, Section 5 concludes the paper.

## 2. Related Work

Various routing protocols have been proposed for a MANET [10-13]. In these protocols, data delivery to a destination is based on a routing table. This approach is satisfactory when the channel quality is very good and nodes are always on but may otherwise be very wasteful.

Das [6] first investigated spatial locality in mobile ad hoc networks in the context of node mobility. They observed that when a mobile node moves, “it cannot move too far too soon.” Query localization techniques exploit this property to lower routing overhead during route discovery and repair.

Gafni [7] uses a series of “link-reversals” to form a directed acyclic graph (DAG) rooted at the destination. One problem is that this protocol, which came to be known as GB, exhibits instability when the network is partitioned.

Qin [8] concentrate on the impact of realistic physical layer (shadowing propagation model) on simulating the performance of well-known ad hoc on-demand distance vector (AODV) and dynamic source routing (DSR) on-demand wireless routing protocols.

MIT group [9] proposed to use the expected transmission count metric (ETX) for finding high throughput paths on multi-hop wireless networks. The ETX metric takes into account the effects of link loss ratios, asymmetry in the loss ratios between the two directions of each link and interference among links of a path.

Hightower [14] proposed a position based approach in routing becomes practical due to the rapidly developing software and hardware solutions for determining absolute or relative positions of nodes in indoor/outdoor ad hoc networks.

Stojmenovic [15] addressed the problem of designing location update schemes to provide accurate destination information and enable efficient routing in mobile ad hoc networks appears to be more difficult than routing itself.

## 2. Proposed Work

To enhance the efficiency of successful data transmission in an ad hoc network Location based Multi Hop Forwarding LMHF method has been proposed. It is composed of two steps, the Next Hop Node Forwarding and the Selecting Next Node Transmission.

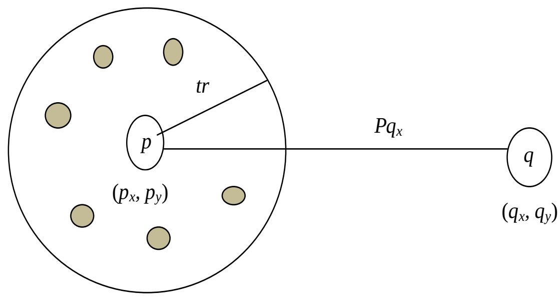


Fig 1. Next hop Node Forwarding

- In Next Hop Node Forwarding step, data transmission either through direct delivery path or multi-hop path is decided.



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- In Selecting Next Node Transmission step, for multi-hop path the intermediate neighbouring nodes are selected for reliable and less overload data transmission.

### 3.1 Next-Hop Node Forwarding

A wireless network is considered with a random deployment of nodes, with data transferring between source *p* and destination *q* as in Fig. 1. Let the distance between the source and the destination be $pq_x$ and the transmission radius be *tr*. When $pq_x$ distance is less than or equal to *tr* distance, data are transmitted through Direct Data Transmission DDT. In DDT, data delivery to *q* can be directly completed and the data packets are directly transmitted to destination without any intermediate node. If $pq_x$ is greater than *tr*, which means *q* is outside the transmission range of *p*, therefore data are transmitted through to *q* through multiple hops by Next Node Transmission NNT. In NNT, data are transmitted to the next hop node that is in the transmission location of destination. If there is no next hop node in the direction of destination in the forwarding area, *p* performs NT. In NT *p* does not forward the data but discards it after a predefined time. The next-hop node for forwarding data is explained as in equation (1).

$$\begin{cases} DDT \ ; \text{if} \left( pq_X \leq tr \right) \\ NNT \ ; \text{if} \left( pq_X > tr \right) \\ NT \ ; \text{if} \left( no\ forwarder \right) \end{cases} \quad (1)$$

The random variable corresponding to the probability of successful delivery is denoted by P. Let M be the random variable corresponding to the probability of successful delivery under the condition that $pq_x>tr$. If the condition $pq_x>tr$ is satisfied Z becomes one as in the following expression (2).

$$P = \begin{cases} 1, & \text{if } pq_X \leq tr \\ M, & \text{if } pq_X > tr \end{cases} \quad (2)$$

### 3.2 Selecting Next Node Transmission

In this paper, selection of next node for transmission is discussed because this problem is almost difficult. As the proposed method forwards a data in broadcast transmission, no transmission control is employed so data can be distributed in all directions by every neighbouring node. This would lead to the consumption of unnecessary wireless resources, and the communication quality of the entire network would degrade. Therefore, to minimize the unnecessary consumption of wireless resources, each node must generate a forwarders list based on destination location information. The process of generating a forwarders list for the source node is explained here. The source can receive the location information of the destination only if it receives an acknowledgement packet from the destination. In this step, only the next neighbouring nodes information is inserted in the forwarders list and but also it is updated periodically in a hop-by-hop fashion because it is difficult to maintain a static route from the source to the destination. The forwarder list size depends on the number of intermediate nodes in the transmission path.

To make a communication with destination, the source must first obtain the location information of the destination. In this paper, it is assumed that the source obtains the location information of the destination by broadcasting AODV message. After obtaining the location information of the destination ($q_x$, $q_y$), the source calculates the distance to the destination ($pq_x$) by equation (3), where,


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$(sx, sy)$ indicates the location information of the source node

$$pq_x = \sqrt{\left(p_x - q_x\right)^2 + \left(p_y - q_y\right)^2} \qquad (3)$$

In order to make a forwarders list, the source also calculates the distances between each one-hop neighbouring node. Each intermediate node in the transmission path also uses the same method to select its next forwarder towards destination. The node with lesser distance is chosen as the next intermediate forwarder and the identified node is updated in the forwarders list. Thus, this process provides the direction in order to deliver packets to the destination. In this way, data reach the destination. If more neighbouring nodes are selected, this will increases the network load, but the proposed method restrict the number of neighbouring nodes.

## 4. Performance Evaluation

This section explains the performance of the proposed method in an ad hoc network through simulation experiments using ns-2. It demonstrates the basic communication performance of the proposed Location based Multi Hop Forwarding LMHF method and Contention based Geographic Forwarding CGF technique [16]. Section 4.1 explains the performance for average number the neighbours against LMHF and CGF methods. Section 4.2 describes the performance of number of packets forwards and number of packets reaching the destination against speed.

### 4.1 Impact on Average number of neighbours

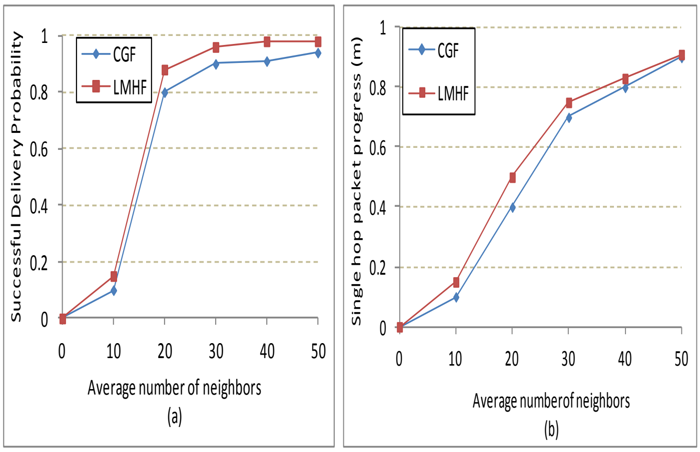


Fig. 2 Simulation results a) Successful Delivery Probability b) Single hop packet progress

In the first and the second set of experiments, average number of neighbours is compared against successful delivery probability and single hop packet progress. Fig. 2(a) shows the average successful delivery probability obtained by simulations. As the number of average neighbours increases, the successful delivery probability also increases. From the figure it is observed that the successful delivery probability is higher for the proposed method when compared to CGF method. Fig. 2(b) shows the average number of neighbours and the average single-hop progress obtained by simulations. The main reason is that the last-hop progress, where a packet is directly delivered to a destination, is often less than the progress in the previous hops, where a packet is greedily forwarded. As the number of average neighbours increases, the single hop packet progress also increases.

### 4.2 Impact on Number of Packets Transmitted


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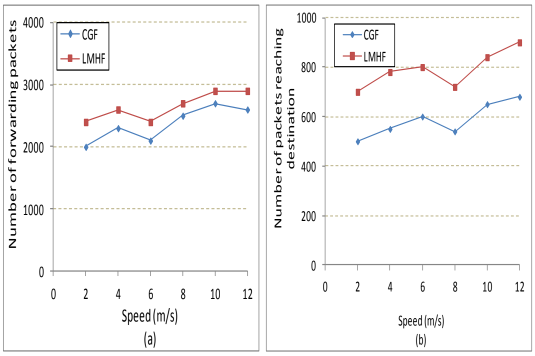


Fig. 3 Simulation results a) Number of forwarding packets b) Number of packets reaching destination

The third and fourth set of experiments shows how the source node's movement speed affects the communication performance of the proposed method. It is compared against number of packets forwarded and number of packets reaching destination. Fig. 3(a) shows the simulation results obtained against the number of packets forwarded and the source movement speed. As the speed increases, the number of packets forwarded also increases. From the figure, it is observed that packets forwarded count is higher for the proposed method when compared to CGF method. Fig. 3(b) shows the simulation results obtained against the number of packets reaching the destination and the source movement speed. As the number of speed increases, the number of packets reaching the destination also increases.

## 5. Conclusion

In this paper, a location based route discovery method based on the multi hop distance information is studied in an ad hoc network. To enhance reliable communication, the proposed method first employs next hop node forwarding to identify whether to transmit directly or through multiple hops. In addition, the proposed method uses the location information and the transmission probability of its own intermediate nodes to efficiently deliver packets to the destination. In this method, all the intermediate nodes update itself with the latest location information periodically and update in the forwarders list. Thus, the proposed method can deliver data without having to share the communication quality of each node over the entire network. The communication performance is also simulated through four sets of experiments. The results of these experiments revealed that the proposed method provides better performance and also achieve efficient delivery with low network overload load when the movement speed is relatively slow.

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