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Mobile Ad hoc Networks – Dangling issues of optimal path strategy

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Abstract: Ad Hoc network is a collection of wireless mobile hosts forming a temporary network without the aid of any centralized administration, in which individual nodes cooperate by forwarding packets to each other to allow nodes to communicate beyond direct wireless transmission range. Routing is a process of exchanging information from one station to other stations of the network. Routing protocols of mobile ad-hoc network tend to need different approaches from existing Internet protocols because of dynamic topology, mobile host, distributed environment, less bandwidth, less battery power. The key concern is to analyze the ability of moving nodes in the network using Random Direction Mobility model based on the path availability.

Key Words: Mobile ad hoc networks, Routing, Path stability

Introduction: Mobile ad hoc networks (MANETs) enable users to maintain connectivity to the fixed network or exchange information when no infrastructure, such as a base station or an access point, is available. This is achieved through multihop communications, which allow a node to reach far away destinations by using intermediate nodes as relays. The selection and maintenance of a multihop path, however, is a fundamental problem in MANETs Node mobility, signal interference[1], and power outages make the network topology frequently changes as a consequence, the links along a path may fail and an alternate path must be found. To avoid the degradation of the system performance, several solutions have been proposed in the literature, taking into account various metrics of interest. A method that has been advocated to improve routing efficiency is to select the most stable path, so as to avoid packet losses and limit the latency and overhead due to path reconstruction (routing instability).

Issues in forwarding packets: A fundamental issue arising in mobile ad-hoc networks (MANETs) is the *selection of the optimal path* between any two nodes. While general approaches are available in literature that can't work better for MANET where node life time is much smaller. A method that has been advocated to improve routing efficiency is to select the most *stable path* so as to reduce the latency and the overhead due to route reconstruction. This paper focuses on how to find the optimal path solution using Random Direction Mobility model based on the neighborhoods detected.

Related Work: We first highlight the path selection using Random Direction Mobility Model.

In the previous work parameters of the underlying mobility model of the nodes are given (e.g., obtained through measurements) and that all nodes have a fixed, common radio range R. To introduce the problem of path selection, suppose node A wants to communicate with node B, possibly using intermediate nodes as relays[2]. To maximize the stability of the route in response to node mobility, one can think of two different strategies: (i) a few long hops; (ii) many short hops. On the one hand, considering that the entire path fails if just a single link fails, and nodes move independently of each other, it seems better to minimize the number of hops. On the other hand, short links are much more stable than long links.

- ***Neighborhood Detection using Low Probability Model*:**

The main challenge in mobile ad hoc networks is mobility. Due to the moving node in the mobile ad hoc network, the route breaks frequently. In most of algorithms in the mobile ad hoc network, when constituting a route to destination node, the previous relay node will select as furthest node as possible to construct shortest path[3]. The furthest node the previous node selects as the next hop relay node, the more possibly the link of the route will break in a short time. Researches need to be done in order to study the relation between the link and route maintenance probability and factors that affect the link and route maintenance probability. In this paper, we suggested the link maintenance probability model. And based on the link maintenance probability, route maintenance probability model was provided for mobile ad hoc networks.

We can write an exact expression for the probability of link availability at time t, by using the spatial PDF of nodes moving according to the RD model. Two nodes A and B be the spatial distributions of A at time t in the move and pause phases, respectively, the spatial distributions of B at time t in the move and pause phases, respectively. The probability of link availability between the two nodes. First to numerically evaluate the spatial distribution of nodes A and B at time t through a tri-dimensional inverse transform (two spatial dimensions and one temporal dimension), then to numerically compute the integral in over a four-dimensional domain.

- **Link Maintenance**

The link maintenance probability model[3] is derived according to problem statement definition. Under the considerations of the problem statement, we make the following as the conclusion that the probability *p* that the two nodes, node *a* and node *b* can communicate after *t* seconds is equal to equation as,

$$P=(A_A \cap B_B)$$

In this link maintenance probability model, *p* is the link maintenance probability, *AA* is the area of circle A, which has its center located at A and has a radius of *R*. *AB* is the area of circle B which has its center located at B and has a radius of *vt*.

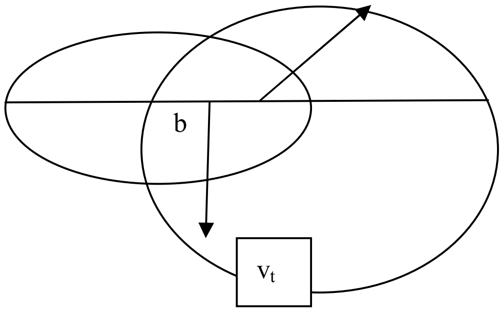


Fig.1. Link Maintenance

Link Maintenance: The probability that node *a* can communicate with node *b* is the ratio of the overlapping area of circle A and circle B to the area of circle B.Fig.1 illustrates the scenario.

MANET Research Approach: The proposed approach projects a refined solution to the overheads caused due to flooding, delay in propagation, difficulty in tracing the optimal path solution. We propose a solution based on an iterative procedure of four steps: (1) Detection of Neighborhoods, (2) Tracing of paths between Source and Destination nodes,(3) a means of augmenting the path set, and finally, (4) a simple discussion on the selection criteria, so that the path search may *temporarily* use edges of paths already included in the set. Fig.2 shows the proposed analogy.

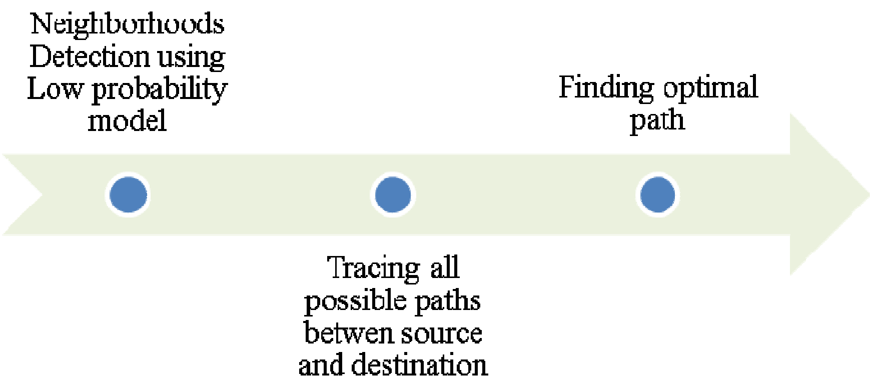
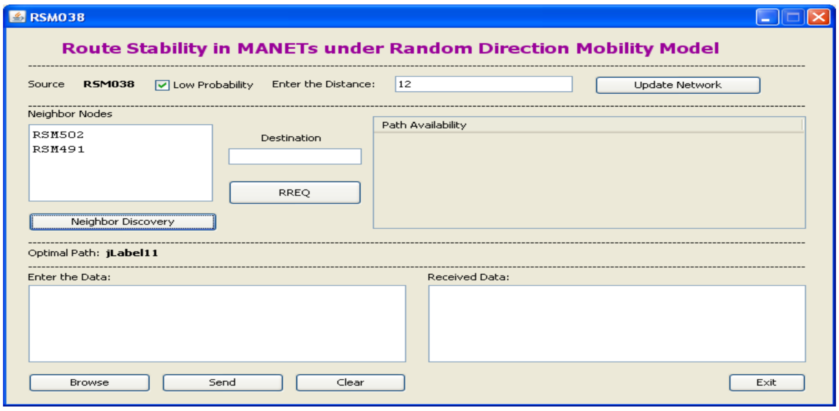


Fig.2

Neighborhoods Detection using Low probability model: This has been implemented in JAVA.The code and the output is as follows.

Snippets of Implementaion:

```
Enumeration<Object> em = properties.keys();
while (em.hasMoreElements()) {
    String key = (String) em.nextElement();
    int dis = Integer.parseInt(properties.getProperty(key));
    int min = mydis - 10;
    int max = mydis + 10;
    if ((!key.equals(source)) && dis >= min && dis <= max) {
        neigh.add(key);
```



- ***Tracing all possible paths (routes)between source and destination nodes:***

Each node alternates periods of movement (move phase) to periods during which it pauses (pause phase); at the beginning of each move phase, a node independently selects its new direction and speed of movement. Speed and direction are kept constant for the whole duration of the node move phase; the durations of move and pause phases are, in general, distributed according to independent random variables.

Properties:

Stationary properties of node distribution and speed distribution are Firstly; geometric probability was applied to analyze stationary node distribution. A closed form probability density function for circular regions was obtained which indicated that mobile nodes tended to disperse with simulation advancing. Secondly, we applied palm calculus to calculate probability density function of stationary speed distribution and proved that there was speed decay phenomenon in this model. RD's mobile moves by a zigzag way. We apply geometric probability to analyze node distribution of RD model. In the case of circular regions, a closed form node distribution is obtained.

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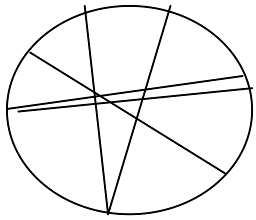


Fig:3.RD Mobility Model

RD – Random direction

We analyze the speed distribution of RD by the method of palm calculus[1] and give a general explanation to the hypostasis of speed decay phenomenon. At last, it should be noted that the appellation "random direction model" is also used for RW model.

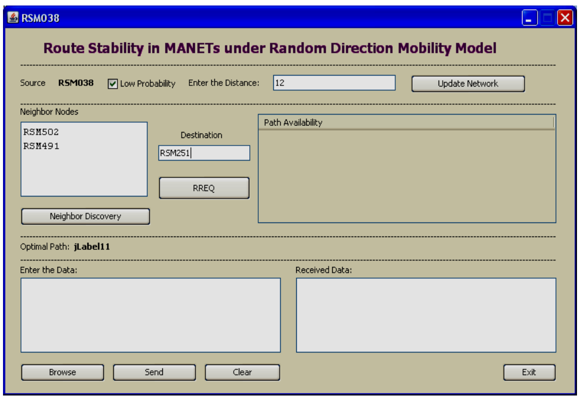
Example:

RD Mobility Model – **Travelling Pattern (route)**

RD nodes will appear near the region border with much higher probabilities and the average speed will decay as time goes by. Theoretical analysis and simulations show that RD is an entity mobility model neither stationary in time nor homogeneous in space. The code and the output is as follows.

Snipptes of Implementation:

```
str=String.valueOf(rr.nextInt(10))+String.valueOf(rr.nextInt(10))+String.valueOf(rr.nextInt(10))
+String.valueOf(rr.nextInt(10));
soc = serSoc.accept();
ois = new ObjectInputStream(soc.getInputStream());
String str = (String) ois.readObject();
checkStatus(str);
```



- ***Finding optimal paths:***

The parameters of the underlying mobility model[3] of the nodes are given (e.g., obtained through measurements) and that all nodes have a fixed, common radio range R. To introduce the problem of path selection, suppose node A wants to communicate with node B, possibly using intermediate nodes as relays.

To maximize the stability of the route in response to node mobility, one can think of two different strategies: 1) Few long hops and 2) Many short hops.

On the one hand, considering that the entire path fails if just a single link fails and that nodes move independently of each other, it seems better to minimize the number of hops. On the other hand, short links are much more stable than long links.

Path selection

- To maximize the stability of the route in response to node mobility, one can think of two different strategies:
    - Few long hops
    - Many short hops.
- On the one hand if entire path fails or else just a single link fails and that nodes move independently of each other, it seems better to minimize the number of hops. On the other hand, short links are much more stable than long links.

We make the following assumptions that if the distance between source node and destination node is l and distance between two intermediate relay nodes is d, then for the convenience of this study, we assume that the hop count of the route h is $h=l/d$. In this circumstance, the link maintenance probability between two intermediate relay nodes is already derived to be p as described in the previous section. But the route was consisted of h hops, which means that there are h links between source and destination.

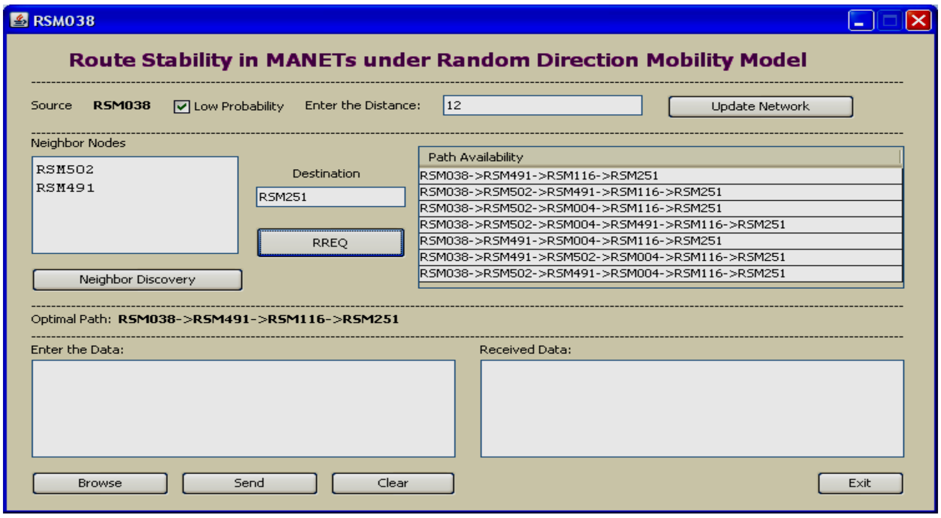
Under these assumptions, the route maintenance probability model is derived as follow.

$$P_R=P^h$$

P_R denotes the route maintenance probability, p denotes the link maintenance probability and h is the hop count. The code and the output is as follows.

Snippets of Code

```
for (int i = 0; i < neigh.size(); i++) {
String nei=neigh.get(i);
    if (getAvailable(path,nei)) {
int nPort = getPort(nei);
Socket socket = new Socket("localhost", nPort);
ObjectOutputStream oos = new ObjectOutputStream(socket.getOutputStream());
oos.writeObject("RTS");
oos.writeObject(path);
oos.writeObject(dest);
```



Conclusions

Analytical theory about the parameterization of mobility nodes is discussed.Route maintenance probability model performs well as the link maintenance probability is considered. The performance of an ad hoc network protocol vary significantly with different mobility models.

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