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# Mobile Ad Hoc Route Repair Algorithm Based on On-the-fly Strategy

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***ABSTRACT.*** *For the local repair of the route algorithm of mobile Ad Hoc network, this paper analyzes the impact of the large amount of control overhead generated by the flooding of the whole network adopted by the traditional repair method on the service transmission delay and the successful delivery rate of the packet. Besides, based on the on-the-fly strategy of mobile Ad Hoc network route repair algorithm, this study constructs a repair model that limits the repair request region to two hops, and establishes the corresponding repair function, so as to achieve the goal of reducing the network flooding and control overhead on the premise of satisfying the repair probability.*

***KEYWORDS:*** *mobile Ad Hoc network; route repair; on-the-fly strategy*

## 1. Introduction

As an important branch of wireless mobile communication network, mobile Ad Hoc network has the advantages of not relying on pre-built infrastructure, fast networking and flexible development. In order to repair the service transmission path in the dynamic non-central network environment, mobile Ad Hoc network needs to update the routing status of the whole network periodically with the first-responder routing protocol, and save the routing table containing link information between all nodes in the network, so as to generate large energy consumption and network control overhead. The mobile Ad Hoc network is a self-organizing wireless communication network with a highly dynamic topology structure and nodes moving arbitrarily. The network structure is shown in Figure 1.

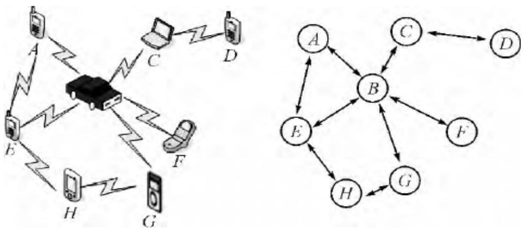


*Figure 1 Mobile Ad Hoc network structure*

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## 2. Related concepts

### *2.1 Mobile Ad Hoc network*

Mobile Ad Hoc network is also known as Multi-hop Wireless Network. The mobile Ad Hoc network is composed of a group of mobile terminal nodes with wireless communication transceivers. It is a multi-hop temporary and non-central network, which can quickly build a mobile communication network at any time and any place without the support of existing basic network facilities, and each terminal is equal in status and provides routing services for other nodes by default. Mobile Ad Hoc network is a kind of network combining mobile communication and computer network. On the one hand, information exchange in network adopts the packet switching mechanism in computer network, rather than the circuit switching mechanism in telephone network. On the other hand, the user terminal is mobile portable terminal, such as laptop, PDA, etc., equipped with corresponding wireless transceiver equipment, and the user can move or be in a static state at will. In mobile Ad Hoc network, each user terminal can not only move, but also have the dual functions of host and router. As the host, the terminal needs to run a variety of user-oriented applications. Meanwhile, as a router, the terminal needs to run the corresponding routing protocol, and complete the packet forwarding and routing maintenance of data according to the routing strategy and routing table. After some networks are destroyed, the distributed control and non-central network structure can maintain the remaining communication capacity and ensure the smooth communication command with strong robustness.

### *2.2 Mobile Ad Hoc network features*

The main features of mobile Ad Hoc network are as follows:

(1) Mobile Ad Hoc network, which requires little fixed infrastructure support, can be deployed flexibly;

(2) Since the network infrastructure is not available, these nodes must organize and maintain the network by themselves. The node can detect the existence of other nodes and join the network with them;

(3) When a node moves, the network topology changes, new nodes are added, some nodes leave, or some routes are interrupted. Frequent, temporary and sudden network connection losses occur frequently;

(4) Most nodes are mobile, which means only wireless communication is available;

(5) A node is both a host and a router. A node may want to connect to another node beyond the single-hop distance. For each node, routing function is necessary because the network does not have substructure support and the nodes do not have to be of the same type (such as phone, PDA, laptop sensor, etc.);

(6) Since each node can send traffic to other nodes, multi-hop is possible. Multi-hop is the desired capability in Ad Hoc network, because space does not increase proportionally in single-hop Ad Hoc network, which limits communication

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between nodes;

(7) Nodes can move, so they can't rely on the line, but can only rely on the battery to provide power;

(8) Each node can have different performance. In order to be able to connect to network based on the substructures (forming a hybrid network), some nodes can communicate with more than one type of network;

(9) Mobile Ad Hoc network, which uses wireless transmission, is more vulnerable to enemy interference, eavesdropping and attacks than wired network. The topology of Ad Hoc network can be divided into two forms of Flat Architecture and Hierarchi-cal Architecture. The plane structure of the mobile Ad Hoc network is shown in Figure 2.

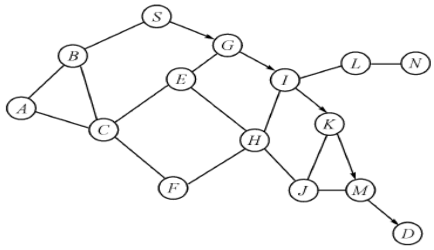


*Figure 2 The plane structure of the mobile Ad Hoc network*

The network of the plane structure is a fully distributed structure. There are generally multiple paths between the source node and the destination node, which can achieve load balancing, and can also select an appropriate path for different service types. All nodes in the network are peer-to-peer. All nodes consist of a single omni-directional station that shares the same random access radio channel in the network. In the plane structure, the coverage of each node is small, and the probability of the signal being intercepted and intercepted is small. Therefore, the network has certain security and robustness. The hierarchical structure of the mobile Ad Hoc network is shown in Figure 3.

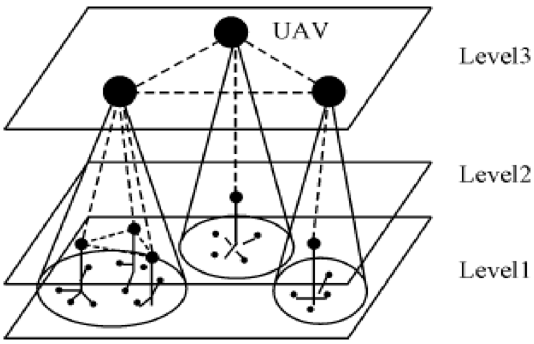


*Figure 3 The hierarchical structure of the mobile Ad Hoc network*

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In this structure, the network is divided into three levels, and communication between the lower nodes utilizes high-level links, which reduces the number of hops between node communications, and can be well used in large-scale communication networks.

## 3. Route repair algorithm based on on-the-fly strategy

The local route repair algorithm based on on-the-fly strategy LRR believes that the individual link interruption caused by the relative motion between nodes in the mobile Ad Hoc network is the main cause of frequent failure of the end-to-end transmission path. The algorithm indicates that when the link is interrupted, all nodes except the node that generates relative motion maintain the routing connection state. The algorithm will decide on one or some nodes in the transmission range of the two nodes at the same time between the interrupted links. Only those nodes whose hop value in the control group TTL domain is less than two hops can process the repair request and forward it. The repair process is initiated by the node on the side of the interrupt link close to the service source node, and the route repair request ends at the Next-to-Next (NN) node.

According to the repair process, the LRR algorithm establishes a local repair system model. The probability $p_0$ of any node Y in the network located in the neighborhood of node X is

$$p_0 = \min\left(1, \frac{\pi r^2}{A}\right) \tag{1}$$

In the formula, r is the node communication radius; eight is the network area. The average number N of neighbor nodes around the node is

$$N_m = \sum_{k=0}^{n-1} k \binom{n-1}{k} p_0^k (1-p_0)^{n-1-k} \tag{2}$$

In the formula, n is the number of nodes in the network. Considering that in a mobile Ad Hoc network with evenly distributed n nodes, the motion speed and direction of all nodes obey the same distribution and the maximum power radius of each node is r, then it is assumed that the arrival time of the service packet obeys the exponential distribution of the mean $1/\lambda$ and when each node's position changes, the interval is equal to the exponential distribution of the mean $1/\mu$. It should be noted that when $\mu = 0$, the mobile Ad Hoc network had been transformed into a static network. Then from (1) and (2), the probability $P_B$ of a link interruption occurring at any node in the network can be known as

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$$P_B = P[M < T]_{[t, t+\delta]} = \int_t^{t+\omega} P[T = x]P[M < x]dx$$
$$= \int_0^{+\infty} P[T = t]P[M < t]dt$$
$$= \int_0^{+\infty} \lambda e^{-\lambda t}(1 - e^{-\mu t})dt = \frac{\mu}{\lambda + \mu} \quad (3)$$

Before the interruption of the link q, the number of links through which the packet passes is subject to the geometric distribution of the random variable Q:

$$P(Q = k) = P_L^{k-1}(1 - P_L) \quad (4)$$

In the formula, PL is the probability that a service packet successfully passes the link.

It can be obtained that the mathematical expectation of the random variable Q is

$$E[Q] = \frac{1}{1 - P_L} \quad (5)$$

Then, before the link is interrupted, the average number of links that the service packet successfully passes is

$$N_P = E[Q] - 1 = \frac{P_L}{1 - P_L} \quad (6)$$

Similarly, if Ps is the probability that the service packet successfully reaches the destination node, then the average number of link interruptions is

$$z_0 = \frac{1 - P_s}{P_s} \quad (7)$$

It can be obtained from equations (6) and (7) that the average cost $C_R$ required for the node of the service packet arrival port is

$$C_R = \left[E_L + \frac{P_L(1 - P_S)}{P_S(1 - P_L)}\right]C_{LS} + \frac{P_L(1 - P_S)}{P_S(1 - P_L)}C_{LF} \quad (8)$$

In the formula, $C_{LS}$ is the cost of the cost link interruption for the successful transmission of the service packet.

According to the two-hop repair model, among the $E_N$ neighbor nodes of node X, the probability $P_W$ of the neighbor nodes at least including node Z is

$$P_w = 1 - (1 - (1 - P_B)^2)^{E_N} \quad (9)$$

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It can be obtained from equation (9) that the route repair success rate $P_R$ in the LRR algorithm is

$$P_R = 1 - P_{F_0} P_{F_1} = 1 - (1 - P_0)^k (1 - P_0)^{kE_N} = 1 - (1 - P_0)^{\frac{E_L{}^2 E_N}{4}} \quad (10)$$

In the formula, E is the average path length of the node of the service source node and the port.

Therefore, the successful delivery rate for each service packet is

$$P_S = (1 - P_B)^{E_L} + (E_L - 1)(1 - P_B)^{E_L - 2} P_B P_{L_2} + (1 - P_B)^{E_L - 1} P_B P_{L_2} \quad (11)$$

Let $T_{DATA}$ be the size of a service packet, $T_{ACK}$ be the size of the acknowledgment packet, $T_{LRR}$ is the size of the generated service that successfully passes the link under the LRR algorithm, and $T_{RTS}$ and $T_{CTS}$ be the packet sizes of RTS and CTS, respectively. If the repair mechanism is initiated with a probability $P_B$, then the service generated by the successfully repaired node is

$$T_K = 2(T_{RTS} + T_{CTS}) + T_{DATA} + T_{ACK} \quad (12)$$

Therefore, the sum of the transport packets during the repair process is

$$\begin{aligned} T_{REC} &= \sum_{i=1}^{E_N} T_K P_{w_k} \prod_{j=1}^{i-1} (1 - P_{w_j}) + E_N (T_{RTS} + T_{CTS}) \prod_{i=1}^{E_N} (1 - P_{w_j}) \\ &= \frac{P_w}{E_N} \sum_{i=1}^{E_N} T_k \left(1 - \frac{P_w}{E_N}\right)^{i-1} + E_N (T_{RTS} + T_{CTS}) \left(1 - \frac{P_w}{E_N}\right)^{E_N} \quad (13) \end{aligned}$$

## 4. Conclusion

The results show that the LRR algorithm limits the routing information to the local node's two hops during the interrupt link repair process, thus avoiding flooding of control information across the entire network. Therefore, the average transmission delay and the number of control information packets are significantly improved, and this advantage is particularly obvious in an environment with a large number of

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connections and strong network topology dynamics. However, the successful delivery rate of the service packet obtained by the LRR algorithm is not much different from that of the traditional DSR protocol, and in some cases, there is slightly reduction.

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**References**

[1] Relevance-based entity selection for ad hoc retrieval [J]. Faezeh Ensan,Feras Al-Obeidat. Information Processing and Management. 2019(5)
[2] Neural word and entity embeddings for ad hoc retrieval [J]. Ebrahim Bagheri,Faezeh Ensan,Feras Al-Obeidat. Information Processing and Management. 2018(4)
[3] Grammatical agreement processing in reading: ERP findings and future directions.[J]. Molinaro Nicola, Barber Horacio A, Carreiras Manuel. Cortex. 2011(8)
[4] Semantic tagging and linking of software engineering social content[J]. Ebrahim Bagheri,Faezeh Ensan. Automated Software Engineering. 2016(2)
[5] Dynamic decision models for staged software product line configuration[J]. Ebrahim Bagheri,Faezeh Ensan. Requirements Engineering. 2014(2)