Disaster Area Communication Using Neighbor coverage in MANET

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***Abstract*— Mobile ad hoc networks consist of a collection of mobile nodes without having a fixed infrastructure. Due to the infrastructure less network, there exist a frequent link breakage which leads to frequent path failures and route discoveries. So,a neighbor coverage-based probabilistic rebroadcast protocol for reducing routing overhead and propose a rebroadcast delay to determine the rebroadcast order, and then we can obtain the more accurate additional coverage ratio by sensing neighbor coverage knowledge. By using this we can significantly decrease the number of retransmissions so as to reduce the routing overhead, and can also improve the routing performance. But the drawback this method is high congestion and less quality of service. So, in order to overcome this problem we use Disaster Area communication network. The so-called emergency communications at the time of catastrophic disaster etc. is considered to use ad hoc network effectively. Therefore, it is important to configure emergency communications networks that offer required sufficient QOS in disaster conditions using ad hoc networks. In this work, to categorize the information and communication required after a disaster from the viewpoint of time elapsed since the onset of the disaster. We propose a practical and suitable communication model for developing ad hoc network configuration technologies required in order to realize such communications. Experimental results show that the proposed system has less congestion and high routing performance from the existing system.**

***Index Terms*—Mobile Adhoc Network (MANET),Disaster area, Emergency Response team (ERT), Disaster field office (DFO), Regional operation center (ROC).**

I. INTRODUCTION

Mobile ad hoc networks (MANETs) consist of a group of mobile nodes which can move freely. One of the basic challenges of MANETs is the design of dynamic routing protocols with good performance and less overhead [1]. Many routing protocols, such as Ad hoc On-demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR) have been proposed for MANETs [3]. The above two protocols are On-demand routing protocols, and they could improve the scalability of MANETs by limiting the routing overhead when a new route is requested [7].
Forpreventing the number of rebroadcasts can successfully optimize the broadcasting [4], and the neighbor knowledge methods perform better than the area-based ones and the probability-based ones, then we propose a neighbor coverage-based probabilistic rebroadcast (NCPR) protocol [1]. Therefore, 1) in order to effectively exploit the neighbor coverage knowledge, we need a novel rebroadcast delay to determine the rebroadcast order, and then we can obtain a more accurate additional coverage ratio; 2) in order to keep the network connectivity and reduce the redundant retransmissions, we need a metric named connectivity factor to determine how many neighbors should receive the RREQ packet. After that, by combining the additional coverage ratio and the connectivity factor, we introduce a rebroadcast probability, which can be used to reduce the number of rebroadcasts of the RREQ packet, to improve the routing performance.
In the proposed system, disaster area communication is used to improve the quality-of –service in the mobile adhoc networks. The purpose of the Disaster Area communication effort is to improve information exchange and facilitate coordination among: Emergency Support Function (ESF) managers; FEMA national and regional offices and the Disaster Field Office (DFO); State/local entities; and private industry. This is accomplished through the integration of existing information systems, implementation of new, efficient technologies, and interconnection of established networks. This architecture improves information access and exchange between Federal, State and local agencies thereby enhancing their disaster recovery and response efforts.

II. PROBLEMS IN DISASTER AREA

A disaster is the disruption of the normal functioning of a system or community, which causes a strong impact on people, structures and environment, and goes beyond the local capacity of response. Catastrophe is another term used in disaster management. There are two types of catastrophicdisaster; natural phenomena, such as an earthquakes, tsunamis, and floods, and artificial phenomena such as war and terrorism. Here, we mainly focus on sudden natural disasters, such as an earthquake [2]. Stann et al. [5] proposed a Robust Broadcast Propagation (RBP) protocol to provide near-perfect reliability for flooding in wireless networks, and this protocol also has a good efficiency.Usually a catastrophe is considered an extremely large-scale disaster. MANETs are exploited to promptly form disaster-recovery networks for collecting critical information on the conditions of the affected citizens. Different response and information is needed to take the quick action to the disaster area. Communication is possible when source and destination area connected by the wireless network.

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The information is reach to the destination when transmit and reception taking place in the network.

In wired communication the network connection should impossible due to the disaster. In the case of wireless communication the signal for communication is available. The adhoc network is mainly used in the wireless communication. So, here the mobile adhoc networks are used to mobile node communication. Mobile nodes don't have any infrastructure so the link breakage problem in the network should be less.

III. Neighbor Coverage-Based Probabilistic REBROADCAST FOR Disaster

In this Section, calculate the rebroadcast delay and rebroadcast probability of the proposed protocol.We usethe upstream coverage ratio of an RREQ packet receivedfrom the previous node to calculate the rebroadcast delay,and use the additional coverage ratio of the RREQ packetand the connectivity factor to calculate the rebroadcast probability in protocol, which requires that each nodeneeds its 1-hop neighborhood information. And it also calculates the disaster area.

A. Identification of Uncovered Neighbors Set

When node $n_i$receives an RREQ packet from its previous node s, it can use the neighbor list in the RREQ packet to estimate how many its neighbors have not been covered by the RREQ packet from s. If node n_i has more neighbors uncovered by the RREQ packet from s, which means that if node n_i rebroadcasts the RREQ packet, the RREQ packet can reach more additional neighbor nodes. To quantify this, we define the Uncovered Neighbors set U (n_i) of node n_i as follows:

$$U(n_i) = N(n_i) - [N\ (n_i) \cap\ N(s)] - \{s\} \qquad (1)$$

Where N(s) and N (n_i) are the neighbors sets of node s andn_i, respectively. s is the node which sends an RREQ packet to noden_i. From this we obtain the initial UCN set.

B. Determination of Rebroadcast Delay

Due to broadcast characteristics of an RREQ packet, node n_i a receive the duplicate RREQ packets from its neighbors. Node n_i could further adjust the U (n_i) with the neighbor knowledge. In order to sufficiently exploit the neighbor knowledge and avoid channel collisions, each node should set a rebroadcast delay. The rebroadcast delay T_d (n_i) of node n_i is defined as follows:

$$Tp(n_i) = 1 - \frac{|\mathrm{N(s)} \cap \mathrm{N}(n_i)|}{|\mathrm{N(s)}|} \qquad (2)$$

$$T_d\,(n_i) = \mathrm{MaxDelay} \times Tp(n_i)$$

Where $T_p(n_i)$ is the delay ratio of node n_i and MaxDelay is a small constant delay. |.| is the number of elements in a set. The above rebroadcast delay is defined with the following reasons: First, the delay time is used to determine the node transmission order. To sufficiently exploit the neighbor coverage knowledge, it should be disseminated as quickly as possible. When node s sends an RREQ packet, all its neighbors $n_i . i = 1,2, \ldots . . |N(s)|$ receive and process the RREQ packet. We assume that node $n_k$has the largest number of common neighbors with node s, according to (2), node $n_k$has the lowest delay.

C. Determination of Rebroadcast Probability

The node which has a larger rebroadcast delay may listen to RREQ packets from the nodes which have lower one. For example, if node n_i receives a duplicate RREQ packet from its neighbor n_j, it knows that how many its neighbors have been covered by the RREQ packet from n_j. Thus, node n_i could further adjust its UCN set according to the neighbor list in the RREQ packet from n_j. Then, the U (n_i)can be adjusted as follows:

$$U(n_i) = U(n_i) – [U(n_i) \cap \mathrm{N}U(n_j)] \qquad (3)$$

After adjusting U (n_i)the, the RREQ packet received from $n_j$is discarded. When the timer of the rebroadcast delay of node n_i expires, the node obtains the final UCN set. The nodes belonging to the final UCN set are the nodes that need to receive and process the RREQ packet. Note that, if a node does not sense any duplicate RREQ packets from its neighborhood, its UCN set is not changed, which is the initial UCN set. Now, we study how to use the final UCN set to set the rebroadcast probability.

i. Additional Coverage Ratio

We define the additional coverage ratio ($R_a(n_i)$) of node $n_i$as

$$R_a(n_i) = \frac{|U(n_i)|}{|N(n_i)|} \qquad (4)$$

This metric indicates the ratio of the number of nodes that are additionally covered by this rebroadcast to the total number of neighbors of noden_i. The nodes that are additionally covered need to receive and process the RREQ packet. As Ra becomes bigger, more nodes will be covered by this rebroadcast, and more nodes need to receive and process the RREQ packet, and, thus, the rebroadcast probability should be set to be higher.

ii. Connectivity factor

We define the minimum $F_c(n_i)$ as a connectivity factor, which is

$$F_c(n_i) = \frac{N_c}{|N(n_i)|} \qquad (5)$$

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Where N_c= 5.1774 log n, and n is the number of nodes in the network. When | N (n_i)| is greater thanN_c, $F_c(n_i)$ is less than 1. That means node is in the dense area of the network, then only part of neighbors of node n_i forwarded the RREQ packet could keep the network connectivity. And when |N (n_i)| is less thanN_c, $F_c(N_i)$ is greater than 1. That means node $n_i$is in the sparse area of the network, then node n_i should forward the RREQ packet in order to approach network connectivity.

Combining the additional coverage ratio and connectivity factor, we obtain the rebroadcast probability pre (n_i) of noden_i.

$$\text{Pre } (n_i) = F_c(n_i).\, R_a(n_i) \qquad (6)$$

Where, if the pre (n_i) ` is greater than 1, we set the pre (n_i) to 1.

Although the parameter $R_a$reflects how many next-hop nodes should receive and process the RREQ packet, it does not consider the relationship of the local node density and the overall network connectivity. The parameter $F_c$is inversely proportional to the local node density. That means if the local node density is low, the parameter $F_c$increases the rebroadcast probability, and then increases the reliability of the NCPR in the sparse area.

D. *Disaster Area Architecture*

Let *R* be the communication range of node s, and *A* be the covering area of node s. *A* can be obtained by the equation: $A = \pi R^2$. *A1, A2,* and *A3* is sub area of A with radii *r1, r2,* and *r3*, respectively. In this some areas are disaster .We have to give large number of transmission for the nodes in disaster area Even though a large number of rebroadcasts guarantees high reachability, it causes high network bandwidth wastage and many packets collisions. On the other hand, the small number of rebroadcasts results in low reachability, because it cause rebroadcast chain broken so that some hosts may not receive the broadcast packets.

We define the coverage ratio μas follows:

$$\mu = \begin{cases} \frac{A_1}{A_1+A_2+A_3} & For\ Area\ 1 \\ \frac{A_2}{A_1+A_2+A_3} & For\ Area\ 2 \\ \frac{A_3}{A_1+A_2+A_3} & For\ Area\ 3 \end{cases} \qquad (7)$$

When a node receives the broadcast message, its relative distance can be obtained by comparing the signal strength with maximum signal strength. Then the distance to sender can be estimated and the node can determine its coverage ratio μ. We can get the rebroadcast probability (*p*) as follows.

$$p = \alpha\mu \qquad (8)$$

Where, *a* is a sensitivity parameter to control the rebroadcast probability. This approach gives a good approximation in the general distribution of mobile node.

IV. ALGORITHM: A NOVEL ALGORITHM FOR DISASTER AREA ARCHITECTURE IN MANET

1. Initialize N number of nodes
2. Among the N number of nodes randomly set the nodes for ERT, DFO, and ROC.

//ERT-Emergency Response team, DFO- Disaster field office, ROC-Regional operation center

3. Suppose if any disaster occurs
4. If n_{DFO} receives a new $RREQ_{ERT}$ from ERT then
5. Compute initial uncovered neighbors set $U(n_{DFO}, R_{ERT}.id)\ for\ RREQ_{ERT}$
6. $U(DFO, R_{ERT}.id) = N(n_{DFO}) - [N(n_{DFO}) \cap NERT-\{ERT\}$
7. Compute the rebroadcast delay $T_d(n_{DFO})$
8. $T_k(n_{DFO}) = \frac{1-|N(ERT) \cap N(n_{DFO})}{|N(ERT)|}$
9. $T_d(n_{DFO}) = Maxdelay \times T_k(n_{DFO})$
10. Set a Timer($n_{DFO}, R_{ERT}.id$) according to $T_d(n_{DFO})$
11. End if
12. While n_{DFO} receives a duplicate $RREQ_j$ from n_{ROC} before Timer($n_{DFO}, R_{ERT}.id$) expires do
13. { Adjust $U(n_{DFO}, R_{ERT}.id)$}
14. $U(n_{DFO}, R_{ERT}.id) = U(n_{DFO}, R_{ERT}.id) - [U(n_{DFO}, R_{ERT}.id) \cap N_{ROC})]$
15. Discard ($RREQ_{ROC}$)
16. End while
17. If Timer($n_{DFO}, R_{ERT}.id$) expires then
18. {Compute the rebroadcast probability Pre (n_{DFO}): }
19. $R_a(n_{DFO}) = \frac{|U(n_{DFO})|}{|N(n_{DFO})|}$
20. $F_c(n_{DFO}) = \frac{N_c}{|N(n_{DFO})|}$
21. Pre $(n_{DFO}) = F_c(n_{DFO}) . R_a(n_{DFO})$.
22. If Random(0,1)≤ $P_{re}(n_{DFO})$ then
23. Broadcast ($RREQ_{ERT}$)
24. Else
25. Discard ($RREQ_{ERT}$)
26. End if
27. End if s

V. SIMULATION RESULT

Routing load

Normalized Routing Load (or Normalized Routing Overhead) is defined as the total number of routing packet transmitted per data packet.

It is calculated by dividing the total number of routing packets sent (includes forwarded routing packets as well) by the total number of data packets received.

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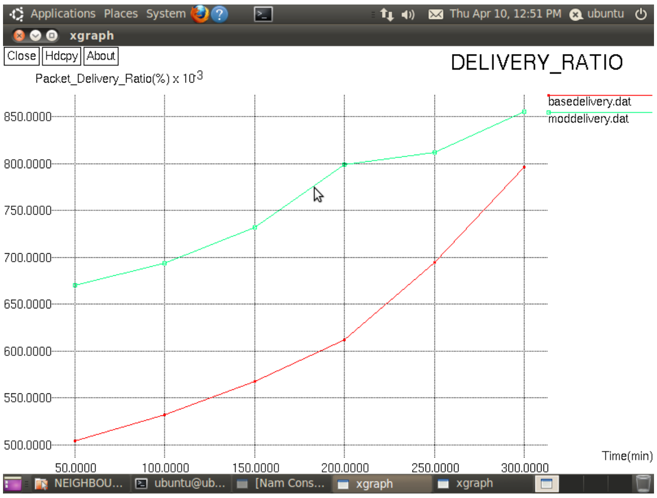

Fig 1: Delivery ratio Graph

The routing load is shown in this graph. In the X-axis time in minutes is taken. Y-axis routing load is taken. This graph clearly shows that the simulation time is increases the routing load is increases in existing neighbor coverage probabilistic rebroadcast method. But in the proposed method, the routing load is decreases.

Collision rate

The amount of packet collisions that occur in a network in a specified time period, usually one minute.

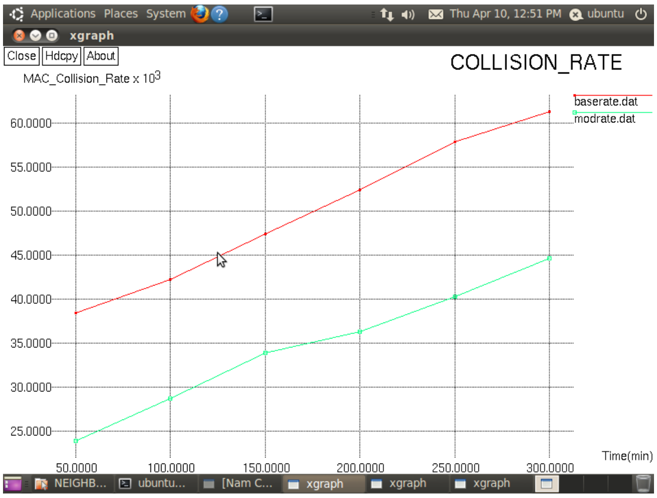

Fig 2: Collision Rate Graph

The Collision rate is shown in this graph. In the X-axis simulation time in minute is taken. Y-axis Collision rate is taken. This graph clearly shows that the simulation time is increases the collision rate is increases in existing neighbour coverage probabilistic rebroadcast method. But in the proposed method, the collision rate is decreases.

Packet delivery ratio

Packet delivery ratio is defined as the ratio of the number of delivered data packet to the destination.

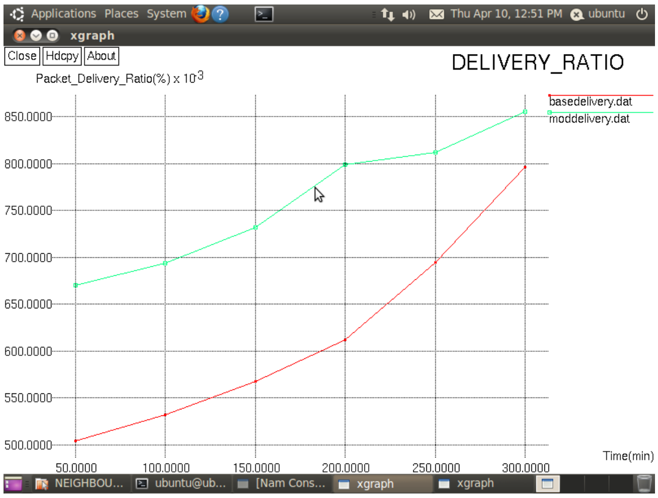

Fig 3: Delivery Ratio Graph

The packet delivery ratio is shown in this graph. In the X-axis simulation time in minutes is taken. Y-axis packet delivery ratio is taken. This graph clearly shows that the simulation time is increases the packet delivery ratio is decreases in existing neighbour coverage probabilistic rebroadcast method. But in the proposed method, the packet delivery ratio is increases.

End-to-end delay

End-to-end delay refers to the time taken for a packet to be transmitted across a network from source to destination.

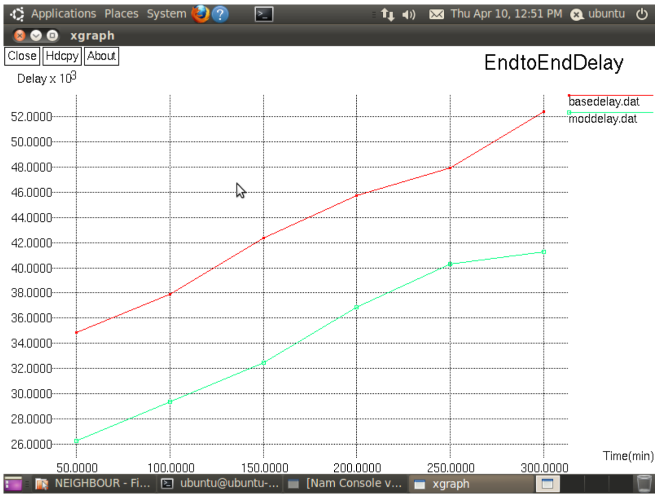

Fig 4: End to End Delay Graph

The end-to-end delay is shown in this graph. In the X-axis simulation time in minutes is taken. Y-axis end-to-end delay is taken. This graph clearly shows that the simulation time is increases the end-to-end delay is increases in existing neighbor coverage probabilistic rebroadcast method. But in the proposed method, the end-to-end delay is decreases.

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VI. CONCLUSION

A neighbor coverage-based probabilistic rebroadcast protocol is used to reduce the routing overhead in the mobile adhoc networks. Because of the random movement of the nodes in the mobile adhoc networks, there is a frequent link breakage which leads to path failure and route discoveries. The Forest Service, at the request of FEMA, is working to develop a system that will automate and coordinate the use of radio frequencies in the field. The disaster area communication was developed to help crystallize and capture information requirements for ESF managers in the field. The benefits of the study include building an understanding of the common problems faced by various ESFs, sharing solutions and best practices to specific problems, and defining improvements that can help ESFs tosuccessfully.

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