A New Rebroadcast Protocol for Mobile Adhoc Networks

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Abstract:

Mobile circumstantial networks include Associate in nursing aggregation of mobile nodes which might travel freely. The nodes may be dynamically self-organized into capricious topology networks while not a mere infrastructure. Imputable to high quality of nodes in Eduard MANET, there exist frequent link breakages that result in frequent path failures and route discoveries. The route overhead of a route discovery can't be neglected. We propose neighbor coverage primarily based probabilistic air protocol for reducing routing overhead in MANETs. So as to effectively exploit the neighbor coverage data, we have a tendency to propose a completely unique air delay to see the air order, so we will acquire the additional correct extra coverage quantitative relation by sensing neighbor coverage data.

***Key word**: neighbor node, broadcast, Route discovery, delay calculation.*

1. INTRODUCTION:

Mobile ad hoc networks (MANETs) consist of a collection of mobile nodes which can move freely. These nodes can be dynamically self-organized into arbitrary topology networks without a fixed infrastructure. One of the fundamental challenges of MANETs is the design of dynamic routing protocols with good performance and less overhead. Many routing protocols, such as Ad hoc On-demand Distance Vector Routing (AODV) [1] and Dynamic Source Routing (DSR) [2], have been proposed for MANETs. 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 [3]. However, due to node mobility in MANETs, frequent link breakages may lead to frequent path failures and route discoveries, which could increase the overhead of routing protocols and reduce the packet delivery ratio and increasing the end-to-end delay [4]. Thus, reducing the routing overhead in route discovery is an essential problem.

2. RELATED WORK:

Several robust protocols have been proposed in recent years besides the above optimization issues for broad-casting. Chen et al. [13] proposed an AODV protocol with Directional Forward Routing (AODV-DFR) which takes the directional forwarding used in geographic routing into AODV protocol. While a route breaks, this protocol can automatically find the next-hop node for packet forwarding. Keshavarz-Haddad et al. [14] proposed two deterministic timer-based broadcast schemes: Dynamic Reflector Broadcast (DRB) and Dynamic Connector-Connector Broadcast (DCCB). They pointed out that their schemes can achieve full reach ability over an idealistic lossless MAC layer, and for the situation of node failure and mobility, their schemes are robustness. Stann et al. [15] 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. They presented a new perspective for broadcasting: not to make a single broadcast more efficient but to make a single broadcast more reliable, which means by reducing the frequency of upper layer invoking flooding to improve the overall performance of flooding. In our protocol, we also set a deterministic rebroadcast delay, but the goal is to make the dissemination of neighbor knowledge much quicker.

EXISTING SYSTEM:

One in every of the basic challenges of MANETs is that the style of dynamic routing protocols with smart performance and fewer overhead.

The traditional on-demand routing protocols use flooding to find a routebroadcast a Route RREQ to the networks, and also the broadcasting induces excessive redundant re-transmissions of RREQ packet and causes the printed storm downside.

PROBLEM STATEMENT:

They broadcast a Route Request packet that results in a substantial range of packet collisions, particularly in dense networks.

Due to node quality in MANETs, frequent link breakages might result in frequent path failures and route discoveries that may increase the overhead of routing protocols and cut back the packet delivery quantitative relation and increasing the end-to-end delay.

3. NEIGHBOR COVERAGE BASED PROBABILISTIC PROTOCOL

In this section, we calculate the rebroadcast delay and rebroadcast probability of the proposed protocol. We use the upstream coverage ratio of an RREQ packet received from the previous node to calculate there broadcast delay, and use the additional coverage ratio of the RREQ packet and the connectivity factor to calculate there broadcast probability in our protocol, which requires that each node needs its 1-hop neighborhood information.

ALGORITHM:

The formal description of the Neighbor Coverage-based Probabilistic Rebroadcast for reducing routing overhead in route discovery is shown in Algorithm1.

Algorithm1.NCPR

Definitions:
$RREQ_v$: RREQ packet received from node v.
R_v:id: the unique identifier(id)of $RREQ_v$.
N(u):Neighbor set of node u.
U(u,x):Uncovered neighbors set of node u for RREQ whose id is x.
Timer (n_i, R_S .id): Timer of node u for RREQ packet whose id is x.
{Note that, in the actual implementation of NCPR protocol, every different RREQ needs a UCN set and a Timer.}

1. **if** n_i receives a new $RREQ_s$ from s then
2. {compute initial uncovered neighbors set $U(n_i, R_s.id)$ for $RREQ_s$: }
3. $U(n_i, R_s.id) = N(n_i) - [N(n_i) \cap N(S)] - \{S\}$
4. [Compute the rebroadcast delay $T_d(n_i)$:]
5. $T_p(n_i) = 1 - \frac{N(s) \cap N(ni)}{N(s)}$
6. $T_d(n_i)$=Max delay $\times T_p(n_i)$
7. Set a Timer (n_i ,R_s .id) according to $T_d(n_i)$
8. **end if**
9.
10. **While** n_i receives a duplicate $RREQ_j$ from n_j before
11. Timer (n_i ,R_s .id) expires **do**
12. {Adjust $U(n_i, R_s.id)$:)
13. $U(n_i, R_s.id) = U(n_i, R_s.id) - [U(n_i, R_s.id) \cap N(n_j)]$
14. discard ($RREQ_J$)
15. **end while**
16. **if** Timer (n_i ,R_s .id) expries then
17. { compute the rebroadcast probability $P_{re}(n_i)$
18. $R_a(n_i) = \frac{U(ni, Rs.id)}{N(ni)}$
19. $F_c(n_i) = \frac{Nc}{N(ni)}$
20. $P_{re}(n_i) = F_c(n_i) . R_a(n_i)$
21. **if** Random (0,1) $\leq P_{re}(n_i)$ then
22. broadcast ($RREQ_s$)
23.
24. **else**
25. discard($RREQ_s$)
26. **end if**
27. **end if**

4. SIMULATION ENVIRONMENT:

In order to evaluate the performance of the proposed NCPR protocol, we compare it with some other protocols using the NS-2 simulator. Broadcasting is a fundamental and effective data dissemination mechanism for many applications in MANETs. In this paper, we just study one of the applications: route request in route discovery. In order to compare the routing performance of the proposed NCPR protocol, we choose the Dynamic Probabilistic Route Discovery [12] protocol which is an optimization scheme for reducing the overhead of RREQ packet incurred in route discovery in the recent literature, and the conventional AODV protocol.Simulation parameters are as follows: The Distributed Coordination Function (DCF) of the IEEE 802.11 protocol is used as the MAC layer protocol. The radio channel model follows a Lucent's WaveLAN with a bit rate of 2 Mbps, and the transmission range is 250 meters. We consider constant bit rate (CBR) data traffic and randomly choose different source-destination connections. Every source sends four CBR packets whose size is 512 bytes per second

. The mobility model is based on the random waypoint model in a field of 1;000 m 1;000 m. In this mobility model, each node moves to a random selected destination with a random speed from a uniform distribution [1, max-speed]. After the node reaches its destination, it stops for a pause- time interval and chooses a new destination and speed. In order to reflect the network mobility, we set the max-speed to 5 m/s and set the pause time to 0. The MaxDelay used to determine the rebroadcast delay is set to 0.01 s, which is equal to the upper limit of the random jitter time of sending broadcast packets in the default implementation of AODV in NS-2. Thus, it could not induce extra delay in the route discovery. The simulation time for each simulation scenario is set to 300 seconds. In the results, each data point represents the average of 30 trials of experiments. The confidence level is 95 percent, and the confidence interval is shown as a vertical bar in the figures. The detailed simulation parameters are shown in Table 1.We evaluate the performance of routing protocols using the following performance metrics:

- **MAC collision rate:** the average number of packets (including RREQ, route reply (RREP), RERR, and CBR data packets) dropped resulting from the collisions at the MAC layer per second.
- **Normalized routing overhead:** the ratio of the total packet size of control packets (include RREQ, RREP, RERR, and Hello) to the total packet size of data packets delivered to the destinations. For the control packets sent over multiple hops, each single hop is counted as one transmission. To preserve fairness, we use the size of RREQ packets instead of the number of RREQ packets, because the DPR and NCPR protocols include a neighbor list in the RREQ packet and its size is bigger than that of the original AODV

TABLE 1
Simulation Parameters

Simulation Parameter	Value
Simulator	NS-2
Topology	1000m * 1000m
Number of Nodes	50,100,150,…,300
Transmission Range	250m
Bandwidth	2Mbps
Interface Queue Length	50
Traffic Type	CBR
Number of CBR Connection	10,12,14,…..20
Packet Size	512 bytes
Packet Rate	4 packet/sec
Pause Time	0s
Min Speed	1 m/s
Max Speed	5 m/s

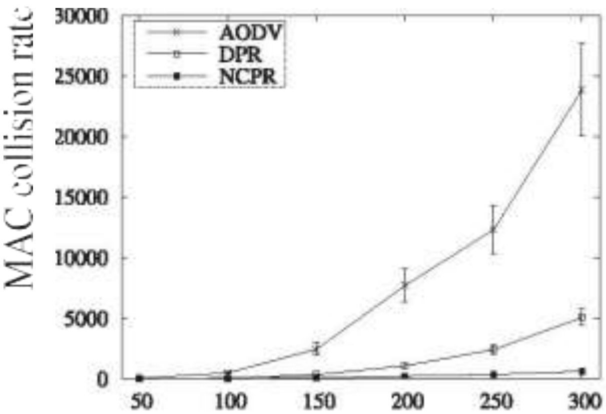
- **Packet delivery ratio:** the ratio of the number of datapackets successfully received by the CBR destinations to the number of data packets generated by the CBR sources.
- **Average end-to-end delay:** the average delay ofsuccessfully delivered CBR packets from source to destination node. It includes all possible delays from the CBR sources to destinations.

The experiments are divided to three parts, and in each part we evaluate the impact of one of the following parameters on the performance of routing protocols:

- **Number of nodes:** We vary the number of nodes from 50 to 300 in a fixed field to evaluate the impact of different network density. In this part, we set the number of CBR connections to 15, and do not introduce extra packet loss.
- **Number of CBR connections**: We vary the number ofrandomly chosen CBR connections from 10 to 20 with a fixed packet rate to evaluate the impact of different traffic load. In this part, we set the number of nodes to 150, and also do not introduce extra packet loss.
- **Random packet loss rate:** We use the Error Modelprovided in the NS-2 simulator to introduce packet loss to evaluate the impact of

random packet loss. The packet loss rate is uniformly distributed, whose range is from 0 to 0.1. In this part, we set the number of nodes to 150 and set the number of connections to 15.

In the experiments analysis, when two protocols are compared, we use the following method to calculate the average: we assume that the varied parameter is (x1, x2, ... ,xn), the performance metric of protocol 1 is (y1, y2, ...,yn)



Number of nodes

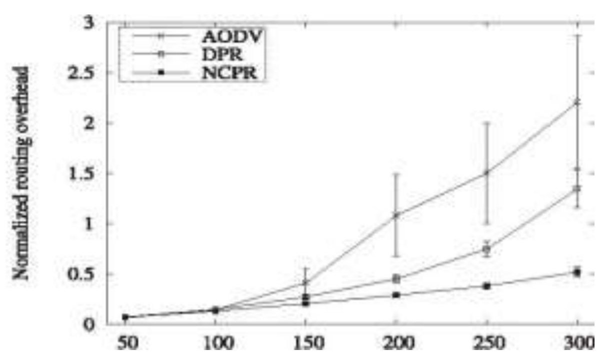
fig 1: MAC collision rate with varied number of nodes

4 PERFORMANCE WITH VARIED NUMBER OF NODES:

Fig.1 shows the effects of network density on the MAC collision rate. In the IEEE802. 11protocol, the data and control packets share the same physical channel. In the conventional AODV protocol, the massive redundant rebroadcast incurs many collisions and interference, which leads to excessive packets drop. This phenomena on will be more severe with an increase in the number of nodes. The packet drops in MAC layer not only affect the number of retransmissions in MAC layer, but also affect the packet delivery ratio of CBR packets in the application layer. It is very important to reduce the redundant rebroadcast and packet drops caused by collisions to improve the routing performance. Compared with the conventional AODV protocol, the NCPR protocol reduces the MAC collision rate by about 92.8 percent on the average. Under the same network conditions, the MAC collision rate is reduced by about 61.6 percent when the NCPR protocol is compared with the DPR protocol. This is the main reason that the NCPR protocol could improve the routing performance.

Fig.2 shows the normalized routing overhead with different network density. The NCPR protocol can significantly reduce the routing overhead incurred during the route discovery, especially in dense network. Although the NCPR protocol increases the packet size of RREQ packets, it reduces the number of RREQ packets more significantly. Then, the RREQ traffic is still reduced.

In addition, for fairness, the statistics of normalized routing overhead includes *Hello* traffic. Even so, the NCPR protocol still yields the best performance, so that the improvement of normalized routing overhead is considerable. On average, the overhead is reduced by about 45.9 percent in the NCPR protocol compared with the conventional AODV protocol. Under the same network conditions, the overhead is reduced by about 30.8 percent when the NCPR protocol is compared with the DPR protocol. When network is dense, the NCPR protocol reduces overhead by about 74.9 and 49.1 percent when compared with the AODV and DPR protocols, respectively. This result indicates that the NCPR protocol is the most efficient among the three protocols.



Number of nodes

Fig 2: Normalized routing overhead with varied number of nodes

Fig. 3 shows the packet delivery ratio with increasing network density. The NCPR protocol can increase the packet delivery ratio because it significantly reduces the number of collisions, which is shown in Fig. 1, so that it reduces the number of packet drops caused by collisions. On average, the packet delivery ratio is improved by about 11.9 percent in the NCPR protocol when compared with the conventional AODV protocol. And in the same situation, the NCPR protocol improves the packet delivery ratio by about 3.7 percent when compared with the DPR protocol. When network is dense, the NCPR protocol increases the packet delivery ratio about 21.8 and 6.3 percent when compared with the AODV and DPR protocols, respectively.

Fig. 4 measures the average end-to-end delay of CBR packets received at the destinations with increasing net- work density. The NCPR protocol decreases the average end-to-end delay due to a decrease in the number of redundant rebroadcasting packets. The redundant rebroadcast increases delay because 1) it incurs too many collisions and interference, which not only leads to excessive packet drops, but also increases the number of retransmissions in MAC layer so as to increase the delay; 2) it incurs too many channel contentions, which increases the backoff timer in MAC layer, so as to increase the delay. Thus, reducing the redundant rebroadcast can decrease the delay. On average, the end-to-end delay is reduced by about 60.8 percent in the NCPR protocol when compared with the conventional AODV protocol. Under the same network conditions, the

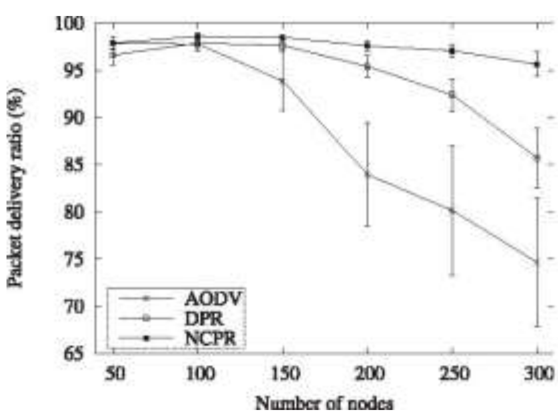


Fig 3: Packet delivery ratio with varied number of nodes

delay is reduced by about 46.3 percent when the NCPR protocol is compared with the DPR protocol. When network is dense, the NCPR protocol reduces the average end-to-end delay by about 84.9 and 59.2 percent when compared with the AODV and DPR protocols, respectively. The NCPR protocol uses a rebroadcast delay based on coverage ratio to replace the random delay in the AODV protocol, and the *MaxDelay* in the NCPR protocol is equal to the upper limit random delay in the AODV protocol, so the NCPR protocol does not cause extra delay cost.

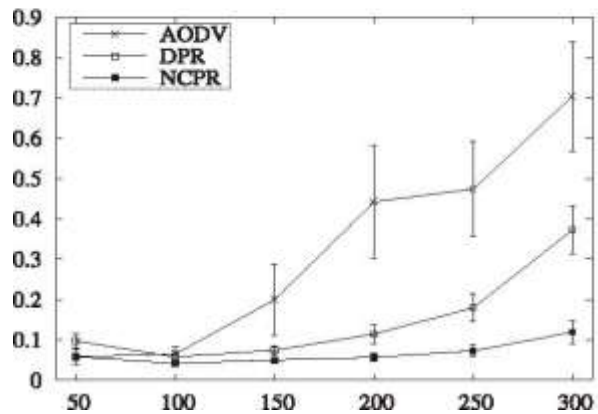


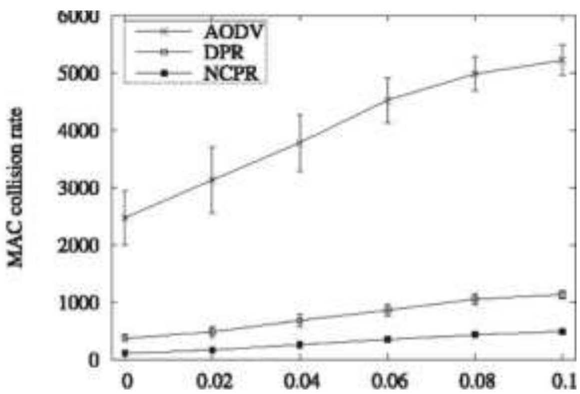
Fig 4: Average end to end delay with varied number of nodes

4.1 PERFORMANCE WIT VARIED RANDOM PACKET LOSS RATE :

Fig.5 shows the effects of the packet loss rate on the MAC collision rate. In our simulation parameters, we use both the *Incoming ErrrProc* and *Outgoing ErrProc* options at the same time; thus, the packet error will be more often and there transmissions caused by random packet loss at MAC layer will be more. Therefore, the MAC collision rate of all the three routing protocols increases as the packet loss rate increases.

The DPR and NCPR protocols do not consider robustness for packet loss, but they can reduce the redundant rebroadcast and alleviate the channel congestion, thus, both of them have the lower packet drops caused by collisions than the conventional AODV protocol. Compared with the conventional AODV protocol, the NCPR protocol reduces the MAC collision rate by about 92.8 percent on the average. In the same network density and traffic load but in different packet loss rate, the MAC collision rate is reduced by about 61.6 percent when the NCPR protocol is compared with the DPR protocol.

Fig. 6 shows the normalized routing overhead with different packet loss rate. As the packet loss increases, there will be more link breakages and route discoveries, and then there will be more routing overhead (such as RREQ packets and RERR packets). On the other hand, the CBR connection using UDP protocol does not have any retransmissions mechanism; thus, the CBR connections will drop more packets as packet loss rate



Random packet loss rate

fig 5: MAC collision rate with varied random packet loss rate

increases. By reducing redundant rebroadcast of RREQ packets, both the DPR and NCPR protocols incur less routing overhead than the conventional AODV protocol. On average, the overhead is reduced by about 59.4 percent in the NCPR protocol compared with the conventional AODV protocol. Under the same network conditions, the overhead is reduced by about 22.3 percent when the NCPR protocol is compared with the DPR protocol.

Fig. 7 shows the packet delivery ratio with increasing packet loss rate. As the packet loss rate increases, the packet drops of all the three routing protocols will increase. Therefore, all the packet delivery ratios of the three protocols increase as packet loss rate increases. Both the DPR and NCPR protocols do not exploit any robustness mechanism for packet loss, but both of them can reduce the redundant rebroadcast, so as to reduce the packet drops caused by collision. Therefore, both the DPR and NCPR protocols have a higher packet delivery ratio than the conventional AODV protocol. On average, the packet delivery n ratio is improved by about 15.5 percent in the NCPR protocol when compared with the conventional AODV protocol. And in the same situation, the NCPR protocol improves the packet delivery ratio by about 1.3 percent when compared with the DPR protocol.

Fig.8 measures the average end-to-end delay of CBR packets received at the destinations with increasing packet loss rate. Due to the increase of packet loss, there transmissions caused by random packet loss at MAC layer will increase so as to increase the end-to-end delay. Both the DPR and NCPR protocols alleviate the channel congestion and reduce the retransmissions caused by collision at MAC layer, thus, both of them have a lower end-to-end delay than the conventional AODV protocol. On average, the end-to-end delay is reduced by about 53.9 percent in the NCPR protocol when compared

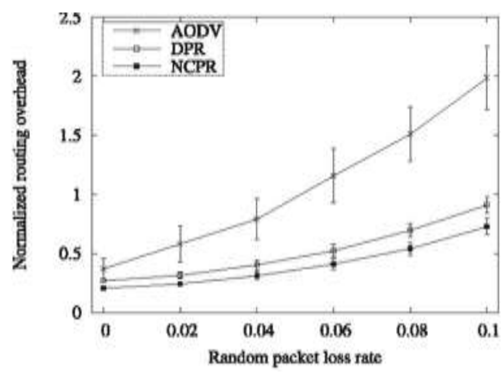


fig 6: Normalized routing overhead with varied random packet loss rate.

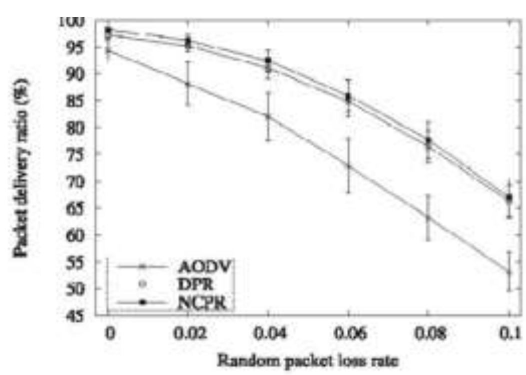


fig 7: Packet delivery ratio with varied random packet loss rate

with the conventional AODV protocol. Under the same network conditions, the delay is increased by about 0.6 percent when the NCPR protocol is compared with the DPR protocol.

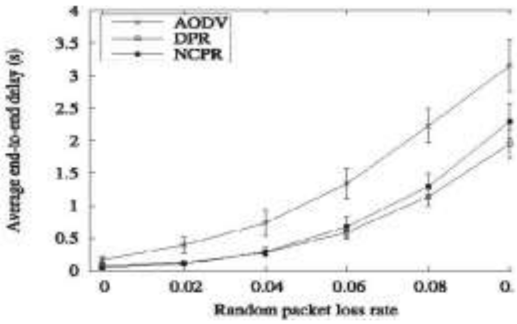


fig 8 :Average end to end delay with varied random packet loss rate

5. CONCLUSION:

In this paper we proposed a probabilistic rebroadcast protocol based on neighbor coverage to reduce the routing overhead in MANETs with source routing. This neighbor coverage knowledge includes additional coverage ratio and connectivity factor. Simulation results show that the proposed protocol generates less rebroadcast traffic than the flooding and some other optimized scheme in literatures. Due to limited time duration compared basic AODV protocol and our proposed protocol NC_AODV

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