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Performance Analysis of Neighbour Coverage Probabilistic Rebroadcast to Reduce the Routing Overhead Over Ad-hoc On Demand Distance Vector Protocol

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ABSTRACT:
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. Existing routing protocol for MANETS has a problem that they used broadcasting which induces excessive redundant retransmissions of RREQ packet and causes the broadcast storm problem, which leads to a considerable number of packet collisions, especially in dense networks. Because of this routing overhead of network increases which leads to broadcast storm problem. Therefore the proposed system try to reduce this routing overhead.

KEYWORDS: Mobile ad hoc networks, neighbor coverage, network connectivity, probabilistic rebroadcast, routing overhead.

I. INTRODUCTION

The ad hoc WLANs do not need any fixed infrastructure. MANETs are self-organizing and adaptive in that the topology of a formed network can change on-the-fly without the intervention of a system administrator [4, 9]. Although MANETs share many of the properties of the traditional wired networks, they possess certain unique characteristics which derive from the inherent nature of their wireless communication medium and the distributed function of their medium access mechanisms. The issues involved may be categorized as follows. Wireless Channel: The wireless communication medium (or channel) is susceptible to a variety of transmission impediments such as path loss, interference and blockage [10,11]. These factors restrict the range, data rate and reliability of the wireless transmission. A signal is considered successfully received at a node if the measured signal to interference and noise ratio (SINR) is large enough to be decoded. Typically, the transmitted signal has a direct path component between the transmitter and receiver [10]. Other components of the transmitted signal referred to as multi-path components are signals reflected, diffracted or scattered by the environment, and arrive at the receiver shifted in amplitude, frequency and phase with respect to the direct-path component [10].

II. AD HOC ON-DEMAND DISTANCE VECTOR (AODV) ROUTING

AODV is a reactive routing protocol that establishes a route to a destination on an on-demand basis, i.e. a route is established only when it is required by a source node for transmitting data packets. This is beneficial to mobile environments such as MANETs since fully up-to-date knowledge of all routes from every node implies large communication overhead. The routing mechanism of AODV consists of two processes; route discovery and route maintenance. When a source node needs to send data, but does not already have a valid route to the destination, it initiates a route discovery process in order to locate the destination. A route request (RREQ) packet is disseminated throughout the entire network via simple flooding [7]. The RREQ packet contains the following main fields: source identifier, destination identifier, source sequence number, destination sequence number (created by the destination to be included along with any route information it sends to requesting nodes), broadcast identifier and time-to-live. The destination sequence number is used by AODV to ensure that routes are loop-free and contain the most recent route information [6, 7]. Each intermediate node that forwards an RREQ packet creates a reverse route back to the source node by imprinting the next hop information in its routing table. Once the RREQ packet reaches the destination or an intermediate node with a valid route, the destination or intermediate node responds by unicasting a route reply (RREP) packet to the source node using the reverse route. The validity of a route at the intermediate nodes is determined by comparing its sequence number with the destination sequence number. Each node that participates in forwarding the RREP packet back to the source creates a forward route to the destination by imprinting the next hop information in the routing table. Nodes along the path from source to destination are not required to have knowledge of which nodes are forming the path other than the next hop nodes to the source and destination. The next phase of the routing mechanism is the route maintenance process. After the route discovery process and as long as the discovered route is used, the intermediate nodes along the active route maintain an up-to-date list of their 1-hop neighbors by means of a periodic exchange of "hello" packets. Also, when the route becomes inactive, i.e. no data is sent over it, a timer is activated, after the expiration of which the route is considered stale and expires. If the routing agent (i.e. AODV) at a node becomes aware of a link breakage for an active route, a Route Error (RERR) packet is generated at the point of breakage. This is then disseminated to the appropriate nodes participating in the route's formation and those nodes actively using the route. The nodes affected by the invalid route mark it for expiration since it is no longer useful. In this fashion, the RERR packet propagates to the source node which can then initiate a new route discovery phase.

III. Neighbour Coverage Probabilistic Protocol (NCPR)

To implement new approach, the Neighbor Coverage-based Probabilistic Rebroadcast protocol is used for reducing routing overhead in route discovery. To implement the the NCPR protocol we modify the source code of AODV in NS-2.32. and also we have to calculate the uncovered neighbor set and rebroadcast delay.To obtain the neighbor information the proposed NCPR protocols Required HELLO packets and also requires to carry the neighbor list in RREQ packets. So we implement the following algorithm called it as NCPR algorithm, which described as follows.

Algorithm

Definition:

$RREQ_V$: RREQ packet received from node v

$R_v.id$: The unique identifier (id) for $RREQ_V$

N(u): NEIGHBOR SET OF NODE u

U(u,x): Uncovered neighbors set of node u for RREQ whose id is x.

Timer (u,x) : Timer of node u for RREQ packet whose id is x.

{Note: In the actual implementation of NCPR protocol every different RREQ needs a UCN set and a Timer }

1. If n_i receive 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 rebroadcast delay $T_d(n_i)$ }

$$T_p(n_i) = 1 - \frac{|N(s) \cap N(n_i)|}{|N(s)|}$$

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5. $T_d(n_i) = MaxDelay \times T_p(n_i)$
6. Set a timer (n_i , $R_s.id$) according to $T_d(n_i)$
7. End if
8. While n_i receive a duplicate $RREQ_j$ from n_j before Timer (n_i , $R_s.id$) expire do
9. { Adjust $U(n_i, R_s.id)$: }
10. $U(n_i, R_s.id) = U(n_i, R_s.id) - [U(n_i, R_s.id) \cap N(n_j)]$
11. Discard ($RREQ_j$)
12. End while
13. If timer (n_i , $R_s.id$) expire then
14. {compute the rebroadcast probability $P_{re}(n_i)$}
15. $R_a(n_i) = \frac{|U(n_i)|}{}$

$$| N(n_i) |$$

16. $F_c (n_i) = \dfrac{N_c}{| N(n_i) |}$

17. Pre (ni) = Fc (ni) . Ra (ni)
18. If Random (0,1) <= Pre (ni) then \
19. Broadcast (RREQs)
20. Else
21. Discard (RREQs)
22. End if
23. End if

Protocol Implementation

We modify the source code of AODV in NS-2 (v2.30) to implement our proposed protocol. Note that the propose NCPR protocol needs Hello packets to obtain the neighbour information, and also needs to carry the neighbour list in the RREQ packet. Therefore, in our implementation, some techniques are used to reduce the overhead of Hello packets and neighbour list in the RREQ packet, which are described as follows: . In order to reduce the overhead of Hello packets, we do not use periodical Hello mechanism. Since a node sending any broadcasting packets can inform its neighbours of its existence, the broadcasting packets such as RREQ and route error (RERR) can play a role of Hello packets. We use the following mechanism [12] to reduce the overhead of Hello packets: Only when the time elapsed from the last broadcasting (RREQ, RERR, or some other broadcasting packets) is greater than the value of Hello Interval, the node needs to send a Hello packet. The value of Hello Interval is equal to that of the original AODV.. In order to reduce the overhead of neighbour list in the RREQ packet, each node needs to monitor the variation of its neighbour table and maintain a cache of the neighbour list in the received RREQ packet. We modify the RREQ header of AODV, and add a fixed field num _ neighbours which represents the size of neighbour list in the RREQ packet and following the num _ neighbours is the dynamic neighbour list. In the interval of two close followed sending or forwarding of RREQ packets, the neighbour table of any node ni has the following three cases: - if the neighbour table of node ni adds at least one new neighbour nj, then node ni sets the num_- neighbours to a positive integer, which is the number of listed neighbours, and then fills its complete neighbour list after the num_ neighbours field in the RREQ packet. It is because that node nj may not have cached the neighbour information of node ni, and, thus, node nj needs the complete neighbour list of node ni;- if the neighbour table of node ni deletes some neighbours, then node ni sets the num_ neighbours to a negative integer, which is the opposite number of the number of deleted neighbours, and then only needs to fill the deleted neighbours after the num_ neighbours field in the RREQ packet; - if the neighbour table of node ni does not vary, node ni does not need to list its neighbours, and set the num_ neighbours to 0. The nodes which receive the RREQ packet from node ni can take their actions according to the value of num_ neighbours in the received RREQ packet: - if the num_ neighbours is a positive integer, the node substitutes its neighbour cache of node ni according to the neighbour list in the received RREQ packet; - if the num_ neighbours is a negative integer, the node updates its neighbour cache of node ni and deletes the deleted neighbours in the received RREQ packet; - if the num_ neighbours is 0, the node does nothing. Because of the two cases 2 and 3, this technique can reduce the overhead of neighbours list listed in the RREQ packet.

IV. PERFORMANCE ANALYSIS OF NEIGHBOUR COVERAGE PROBABILISTIC ROUTING PROTOCOL OVER AD-HOC ON DEMAND DISTANCE VECTOR ROUTING PROTOCOL.

4.1 Performance of NCPR over AODV of End –to-End Delay

Table 1 shows the end-to-end delay by using Ad-hoc on demand .Distance Vector Protocol and Neighbor Coverage Probabilistic Routing Protocol (NCPR). It shows that the Neighbor Coverage Probabilistic Routing Protocol (NCPR) reduce the end to end delay in between nodes as compare to Ad-hoc on demand.

Sr. No.	No. Of Nodes	End- to- End Delay in AODV	End- to- End Delay in NCPR
1	50	0.05	0.15
2	100	0.07	0.09
3	150	0.21	0.05
4	200	0.29	0.18
5	250	0.52	0.10
6	300	1.21	0.27

Table 1. End- to- End Delay in AODV & NCPR

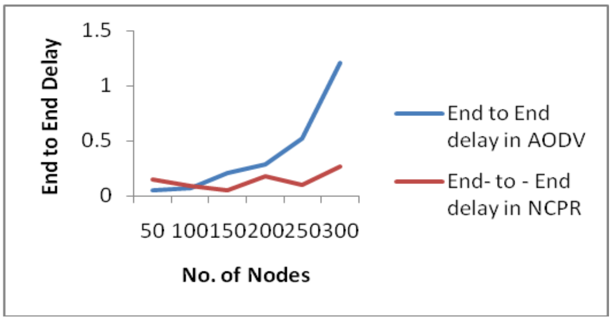

Figure 1. Graphical representation on End to End delay in NCPR & AODV

Distance Vector Protocol on X- axis shows the number of nodes and on Y-axis shows the end to end delay, also red lines shows the end to end delay with Neighbor Coverage Probabilistic Protocols where the green lines shows the end to end delay with Ad-hoc On Demand Distance Vector Protocol.

4.2 Performance of NCPR over AODV of Normalizing Routing Overhead

Table 2 shows the difference in Routing Overhead in route discovery by using Ad-hoc On demand Distance Vector Protocol (AODV) and Neighbour Coverage Probabilistic Routing Protocol (NCPR)., It shows that the routing overhead in route discovery is reduced by the Neighbor Coverage Probabilistic Routing Protocol (NCPR).

Sr. No.	No. Of Nodes	Normalizing Routing Overhead in AODV	Normalizing Routing Overhead in NCPR
1	50	0.63	0.55
2	100	2.58	1.22
3	150	3.63	1.50
4	200	4.70	2.01
5	250	7.09	3.73
6	300	20.87	7.59

Table 2. Normalizing Routing Overhead in AODV & NCPR

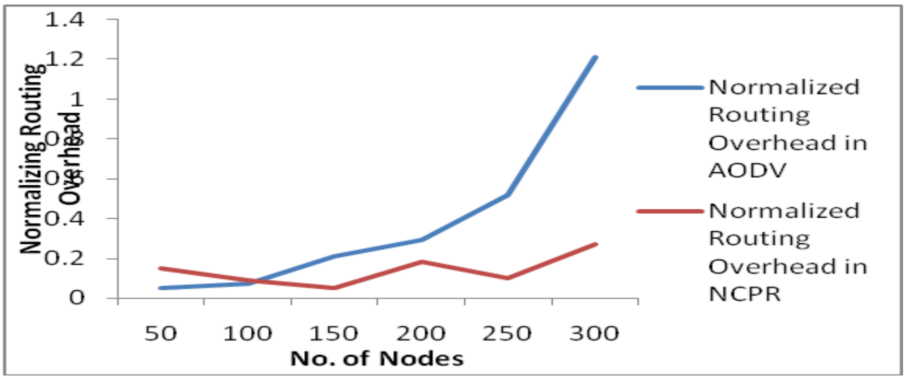

Figure 2. Graphical Representation of Normalizing Routing Overhead in AODV & NCPR

On X- axis shows the number of nodes and on Y-axis shows the Routing Overhead , also red lines shows the end to end delay with Neighbor Coverage Probabilistic Protocols where the green lines shows the end to end delay with Ad-hoc On Demand Distance Vector Protocol

4.3. Performance of NCPR over AODV of Packet Delivery Ratio in NCPR

Table 3 shows the difference in Packet Delivery Ratio by Ad-hoc On demand Distance Vector Protocol (AODV) and Neighbor Coverage Probabilistic Routing Protocol (NCPR)., It shows that the Packet Delivery Ratio is increases by the Neighbor Coverage Probabilistic Routing Protocol (NCPR).

Sr. No.	No. Of Nodes	Packet Delivery Ratio in AODV	Packet Delivery Ratio in NCPR
1	50	98.93	98.14
2	100	97.28	98.31
3	150	97.26	98.22
4	200	96.84	95.78
5	250	90.49	98.08
6	300	82.34	88.23

Table 3. Packet Delivery Ratio of AODV & NCPR

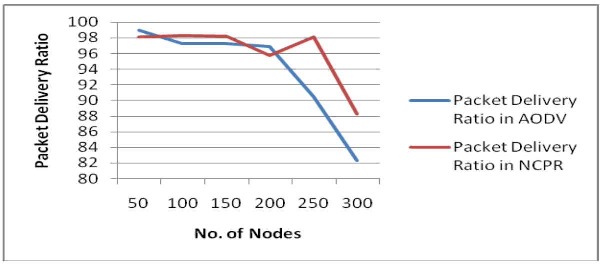

Figure 3. Graphical Representation of Packet Delivery Ratio in AODV & NCPR

On X- axis shows the number of nodes and on Y-axis shows the Packet delivery Ratio, also red lines shows the end to end delay with Neighbor Coverage Probabilistic Protocols where the green lines shows the end to end delay with Ad-hoc On Demand Distance Vector Protocol

V. CONCLUSION AND FUTURE SCOPE

Because of less redundant rebroadcast, the proposed protocol mitigates the network collision and contention, so as to increase the packet delivery ratio and decrease the average end-to-end delay. The simulation results also show that the proposed protocol has good performance when the network is in high density or the traffic is in heavy load. Because of node mobility in MANETs, always there is a greater chance of frequent link breakages between nodes. These frequent link breakages will cause a number of rebroadcasts between nodes and routing overhead. The proposed system robust for reducing routing overhead in MANETs, which uses additional coverage ratio, connectivity factor and high signal strength. Because of less redundant rebroadcast the proposed protocol mitigates the network connection, so as to increase the packet delivery ratio and decrease the average end-to-end delay, thus Quality of service (QOS) routing is maintained. In future this method can be used to check the suitability in VANETS and the same has to be implemented.

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