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Improving the Performance of Routing Protocol Using Neighbor Coverage Based Probabilistic Rebroadcast in Mobile Ad Hoc Network

Richa Sharma
Department of Computer Engineering
Govt. Engineering College Bikaner
Bikaner, India
richaabhisharma@gmail.com

Maninder Singh Nehra
Department of Computer Engineering
Govt. Engineering College Bikaner
Bikaner, India
maninder4unehra@yahoo.com

***Abstract*—** Mobile Ad Hoc Networks provides important control and route establishment functionality for a number of unicast and multicast protocols. To discover an effective and an efficient routing protocol for transmit information from source to destination across whole network topology. This is a main issue in networking research. Broadcasting is important in MANET for routing information discovery, protocols such as ad hoc on demand distance vector (AODV), dynamic source routing (DSR), and location aided routing use broadcasting to establish routes. Broadcasting in MANETs poses more challenging problems because of the variable and unpredictable characteristics of its medium as well as the fluctuation of the signal strength and propagation with respect to time and environment such as bandwidth congestion, channel contention problem, and packet collision problem. To overcome these and reducing routing overhead we did study about neighbor coverage based probabilistic rebroadcast protocol in MANETs. In order to effectively exploit the neighbor coverage knowledge, we also discuss a connectivity factor to provide the node density adaptation. Our approach combines the advantages of the neighbor coverage knowledge and the probabilistic mechanism, which can significantly, optimizes the routing mechanism in comparison to the AODV protocol. We just complete our dissertation work by comparing AODV protocol with the new concept of rebroadcasting is NCPR in point of many performance metrics. The performance results and comparisons are done by using NS-2 simulator.

***Keywords*—** *Ad hoc network, Mobility, Routing protocol, broadcasting techniques, NCPR etc.*

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I. INTRODUCTION

A MANET is an autonomous collection of mobile nodes. A network is decentralized when the network organization and message delivery are executed by mobile nodes. Nodes are stressed with the effects of radio communication, including multi-user interferences, shadowing and multipath fading. The design issue of network protocols for MANET environment is highly complex. These networks need efficient distributed algorithms which are used to determine the connectivity of network organizations, link scheduling, and routing. Routing in MANET is extremely challenging because of MANETs dynamic features, its limited power energy. Due to nodes constantly moving, efficient routing of packets is a primary MANET challenge.

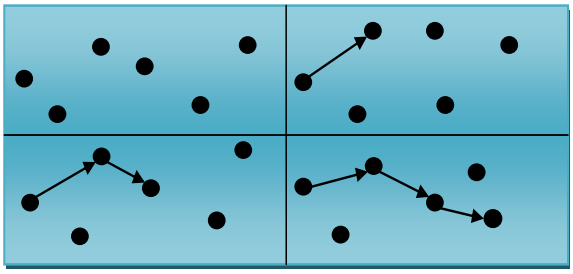

Fig. 1 MANETs can route packets in multiple hops

Figure 1 shows, MANETs can route packets in multiple hops, enabling direct communication between mobile hosts without the need for mobility support router mediation.

A. Routing Protocols in MANET

To design a dynamic routing protocol with good performance and less overhead in MANET is very difficult. So many routing protocols are used in MANET. Basically routing protocols are divided into three categories:

- Proactive routing protocols, the routes to all the destination (or parts of the network) are determined at the starting, and maintained by using a periodic route update process. Each node periodically broadcasts its routing table(s) to its neighbors, allowing all nodes to have a consistent network view. The protocol we use DSDV, FSR, GSR etc. routing protocol.
- Reactive or On-demand routing protocols were designed to reduce the overheads in proactive protocols by maintaining information for active routes only. So that routes are determined and maintained for nodes that require sending data to a exacting destination. Route discovery usually occurs by flooding a route request packets through the network. In this type we use AODV, DSR etc routing protocol.

- Hybrid routing protocol also known as Zone Routing Protocol in the effort to combine the features of proactive and reactive protocols. In this we use ZRP, ZHSL etc routing protocols.

Due to node mobility in MANETs, frequent link breakages may lead to frequent path failures and route discoveries, which could increase the routing overhead and end to end delay and reduces packet delivery ratio. So this is the main problem of our paper. The reactive protocols broadcast RREQ message for rout request in the network, when each node sends RREQ message then the redundant RREQ messages creates a problem in dense networks is called broadcast storm problem [2] which is basically done by flooding which has so many drawbacks like contention, redundant rebroadcast and collision.

B. Taxonomy of Broadcasting

Broadcast is used to diffuse information and route discovery protocols in ad-hoc networks. Broadcasting is a fundamental and effective data dissemination mechanism for route discovery, network services and address resolution in ad hoc networks.

Broadcasting techniques are divided in four categories by Williams and Camp [3] i.e. simple flooding, Probability based methods, neighbor knowledge methods and Area based methods. They showed that an increase in the number of nodes in a static network will degrade the performance of the probability based and area based methods. The Probability-based approach is another simple one. It depends upon pre-defined fixed probability to determine whether it rebroadcast the packets or not. One problem of the probabilistic approach is how to set the rebroadcast probability. The proposed approach dynamically sets the value of the rebroadcast probability for every host node according the host density in its neighborhood. This approach generates less rebroadcasts and has lower broadcast latency and high reach ability. But the neighbor confirmation scheme is to get high reach ability to the last nodes by second retransmission of a packet. It is executed by the nodes which do not rebroadcast the packet according to dynamic probability with coverage area. After a given amount of time *t*, a node checks if all the neighbors have received the broadcast packet. If not, it rebroadcast the packet.

Our main work is that first reduce routing overhead and end to end delay, second increases packet delivery ratio of NCPR. We will compare results of NCPR with on demand routing protocol that is AODV protocol and we show the simulation result by which it will be cleared that NCPR is a good for improving the performance of routing protocol.

II. RELATED WORK

To overcome the broadcast storm problem, channel contention and collision problem so many routing protocol and techniques are proposed as Kim [4] proposed probabilistic broadcasting based on coverage area and neighbor confirmation in mobile ad hoc networks. In which the coverage area of a node used for adjust the rebroadcast probability. He analyzes that neighbor confirmation is better than area based. Abdulai et al. [5] proposed a Dynamic Probabilistic Route Discovery (DPR) scheme based on neighbor coverage. This scheme explains that, each node determines the forwarding probability according to the number of its neighbors and the set of neighbors which are covered by the previous broadcast. Zhang et al. [6] proposed an estimated distance (EstD)-based routing protocol (EDRP) to steer a route discovery in the general direction of a destination, for reducing the routing overhead and restrict the propagation range of route request (RREQ) .

III. PROPOSED WORK FOR IMPROVING PERFORMANCE

For improving the performance of routing protocol we are discussing the ad hoc on demand protocol and neighbor coverage based probabilistic rebroadcast protocol with their working methodology.

A. Ad Hoc on demand Distance Vector

Ad Hoc On-Demand Distance Vector Routing protocol is a pure on-demand route possession system, since nodes do not maintain any routing information and also not participate in any periodic routing table exchanges. It is one of the most important reactive routing protocols and it is mostly used in MANETs. The AODV establishes routes between nodes only on-demand (when they are required to send data packet). There is no need to update all routes in the network; instead it focuses only on routes that are currently used or being set up. The primary objectives of AODV are:

a) To execute path discovery process when necessary. AODV uses broadcast route discovery mechanism.

b) To distinguish between local connectivity management (neighborhood detection) and general topology maintenance

c) To broadcast information about changes in local connectivity to those neighboring mobile nodes those are likely to need the information. The AODV algorithm enables dynamic, multi-hop, self-starting routing between participating mobile nodes wishing to establish and maintain an ad hoc network.

B. Neighbor Coverage Based Probabilistic Rebroadcast Protocol

The neighbor coverage based probabilistic rebroadcast protocol which combines both neighbor coverage and probabilistic methods. In order to successfully utilize the neighbor coverage knowledge, and to determine the rebroadcast order we need a novel rebroadcast delay, and then we can acquire a more accurate additional coverage ratio. We need a metric named connectivity factor to verify how many neighbors should

receive the RREQ packet, for maintaining the network connectivity and reducing the redundant retransmissions. After that, by combining the additional coverage ratio and the connectivity factor, we establish rebroadcast probability, for reducing the number of rebroadcasts of the RREQ packet and to improve the routing performance.

1) Rebroadcast Delay

The rebroadcast delay is to find out the forwarding order. The node has lower delay if it has more common neighbors with the previous node. If this node rebroadcasts a packet by which further common neighbors will know this information. Node pi has more neighbors uncovered by the RREQ packet from s. The meaning of that if node pi rebroadcasts the RREQ packet, then it can reach more neighbor nodes. To quantify of the Uncovered Neighbors (UCN) set U(pi) of node pi as follows:

$$U(pi) = N(pi) - [N(pi) \cap N(s)] - \{s\} \quad (1)$$

The N(s) and N(pi) are the neighbors sets of node. s is sends an RREQ packet to node pi. According to Eq. (1),

In order to overcome the channel collision every node must be find the rebroadcast delay. When we find the rebroadcast delay the protocol affect the neighbor conformation knowledge. So any node will calculate the delay by RREQ packet. The node calculates by checking neighbor list of RREQ packet and itself neighbor list.

The rebroadcast delay Td(pi) of node pi is defined as follows:

$$Tp(ni) = 1 - \frac{|N(s) \cap N(ni)|}{|N(s)|} \quad (1)$$

$$T\,d\,(pi) = Max\ Delay \times Tp(pi) \quad (2)$$

Where Tp (pi) is the delay ratio of node pi, and MaxDelay is a small constant delay. | · | is the number of elements in a set.

2) Rebroadcast Probability

The rebroadcast probability is collection of two factors:

a) Additional coverage ratio: It is the ratio of the number of nodes that should be covered by a single broadcast to the total number of neighbors, and

b) Connectivity factor: It is the relationship of network connectivity and the number of neighbors of a given node that are additionally covered by the node which has a more rebroadcast delay might listen to RREQ packets from the nodes.

node ni could further adjust its UCN set according to the neighbor list in the RREQ packet from nj. Then the U(ni) can be adjusted as follows:

$$U(ni) = U(ni) - [U(ni) \cap N(nj)] \quad (3)$$

The additional coverage ratio Cr(ni):

$$Cr(ni) = \frac{|U(ni)|}{|N(ni)|} \quad (4)$$

Connectivity factor can be defined as:

$$Cf(ni) = \frac{Nc}{|N(ni)|} \quad (5)$$

Nc = 5.1774 log n, the n is the number of nodes in the network.

Combining the additional coverage ratio and connectivity factor, to obtain the rebroadcast probability Pre (ni) of node ni:

$$Pre\ (ni) = Cf(ni) \cdot Cr(ni) \quad (6)$$

Where, if the Pre (ni) is > 1, to set the Pre (ni) to 1.

IV. IMPLEMENTATION

This part of the paper focus on the main implementation work of the paper by which our goal will be fulfilled. For optimization of the routing mechanism using NCPR we will follow some steps these are discussed in next point.

A. Steps of the implementation work

Step 1: Select the Packet Size for Input UDP packets.

Step 2: Create the Protocol NCPR, and get the result for that protocol.

Step 3: Create and Implement the AODV Protocol.

Step 4: Comparing the parameters between NCPR and AODV output's.

Step 5: Computing Performance Matrix

Step 6: Calculating the PDF, Throughput, Delay and Routing Load.

Step 7: Evaluation of Graph.

Step 8: Display the Final Output.

Step 9: Stop.

B. Performance Metrics

We evaluate the performance of the protocol we calculate following performance metrics:

- **Routing** load: Routing Load is the sum of the routing control messages such as RREQ, RREP, RRER, HELLO etc, counted by k bit/s.
  - **Throughput**: Throughput is the ratio of the total amount of data that reaches a receiver from a sender to the time it takes for the receiver to get the last packet is referred to as throughput. It is calculated in packets per second or bits per second. Factors that affect

throughput in MANETs include limited bandwidth and limited energy, frequent topology changes, unreliable communication,.

- **Packet Delivery Ratio**: Packet Delivery Ratio (PDR) is the ratio between the number of packets transmitted lines by a source node and the number of packets received by a sink node. This measures the loss rate by transport protocols. It characterizes the efficiency and correctness of ad hoc routing protocols. Always a high packet delivery ratio is required by a network.
- **End to End Delay**: The packet end-to-end delay is the average time that packets take to traverse the whole network. This time is the generation of the packet by the sender up to their **reception** at the destination's application layer and is calculated in seconds. It therefore includes all the delays in the network such as transmission time, delay and buffer queues induced by routing activities and MAC control exchanges.

V. EXPERIMENTAL RESULT

In order to optimization of routing mechanism of MANET using NCPR We compare results of ncpr with AODV protocol and shows that NCPR is better using four performance metrics these are routing load (energy utilization), throughput, packet delivery ratio, end to end delay.

TABLE I. SIMULATION PARAMETER

Simulation Parameter	**Values**
Simulator	NS-2 (V 2.33)
Channel Type	Wireless Channel
radio-propagation model	Propagation/Two Ray Ground
network interface type	Phy / Wireless Phy
MAC type	Mac 802_11
Interface Queue Type	Drop tail / Pri Queue
Antenna model	Omni Antenna
Maximum Packet Value	50
No. of Mobile Nodes	100
Routing Protocol	AODV/NCPR

The above Table shows the simulator parameters which are required for project.

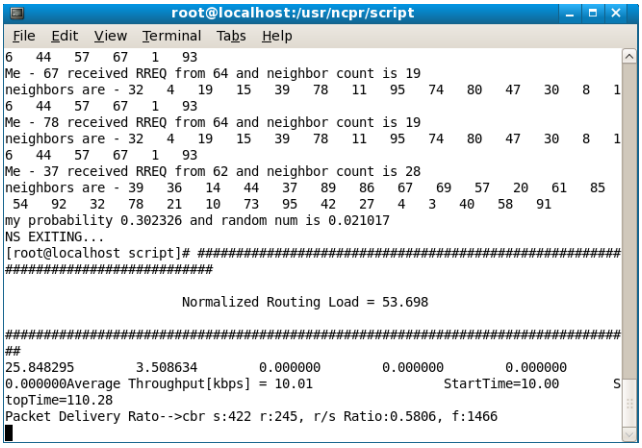

Fig.2. Ns-2 Script Window For Total Performance Metrics Calculation In NCPR

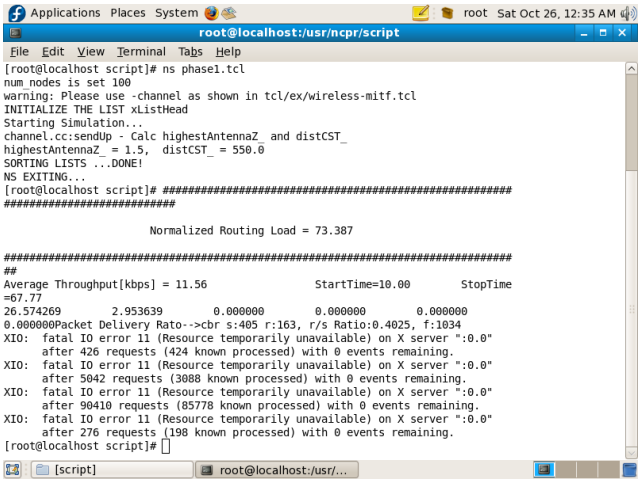

Fig.3. Ns-2 Script Window For Total Performance Metrics Calculation In AODV

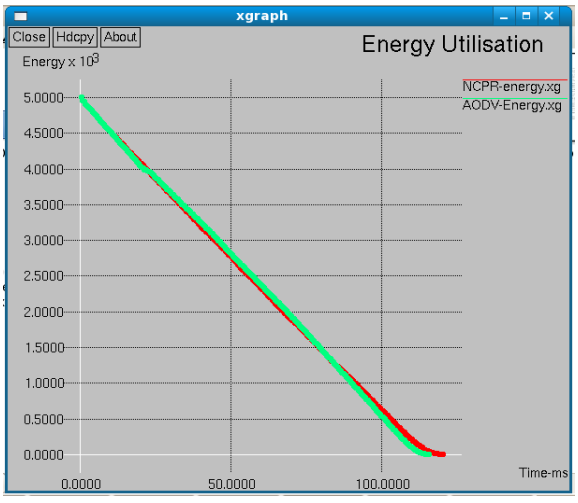

Fig.4. Graph of Energy Utilization

The simulated result shown in figure 4 from this it is cleared that the energy utilization in AODV is not linear as some interval of time the energy changes but it is not happen in NCPR. So we can say NCPR is better in energy utilization.

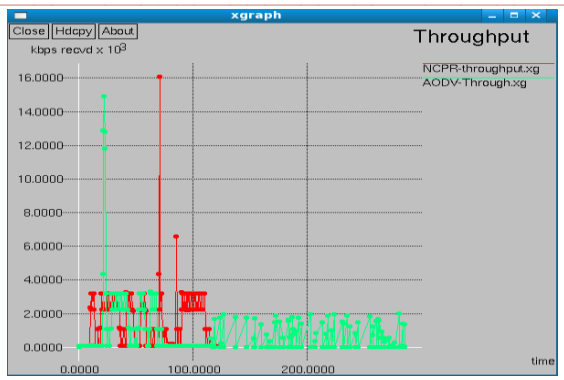

Fig.5 Graph of Throughput

The simulated result shown in figure 5 from this it is cleared that the throughput between the Time and Packet sent kbps. This graph tells that Comparison of Throughput between the AODV protocol and NCPR protocol. The AODV protocol gives the efficient throughput at the end of the packet delivery. But the NCPR protocol gives the most efficient throughput in Starting itself.

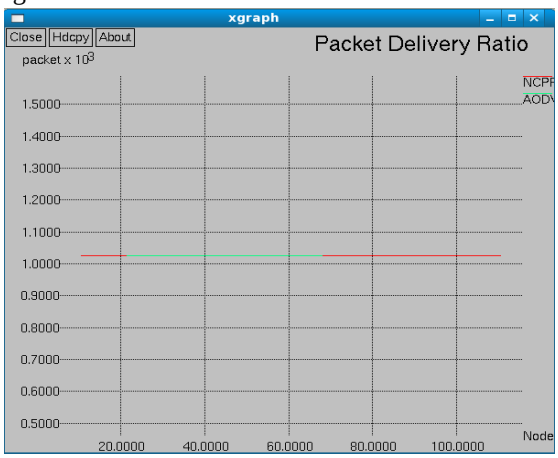

Fig.6. Graph of Packet Delivery Ratio

The simulated result shown in figure 6 from this it is cleared that the Packet Delivery Ratio Comparison between AODV Protocol and NCPR protocol. The Packet Delivery Ratio means plot the graph between Node and Average Packet delivery. It shows that PDR of AODV is efficient for only some number of nodes but for NCPR it good for all nodes.

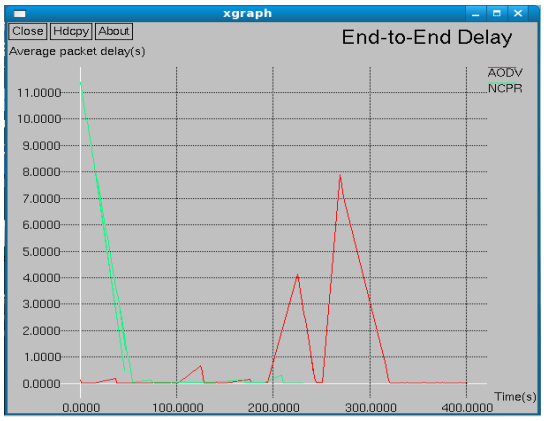

Fig.7. Graph of End to End Delay

The simulated result shown in figure 7 from this it is cleared that the end to end delay of NCPR is high at initial time interval but when time increases the end to end delay will not increases as compared to AODV. In average packet delay of NCPR protocol is more efficient than AODV protocol packet delay.

VI. CONCLUSION

The NCPR protocol a new scheme to dynamically calculate the rebroadcast delay, which is used to calculation of the forwarding order and more effectively exploit the neighbor coverage knowledge. Simulation results show that the NCPR protocol generates less rebroadcast traffic than the AODV protocol. Because of less redundant rebroadcast in the NCPR protocol mitigates the network contention and collision, so as to increase the packet delivery ratio and decrease the average end-to-end delay in comparison to AODV protocol. The simulation results also show that the NCPR protocol has good energy utilization then AODV protocol.

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