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A Neighbor Coverage Based Technique for Reduced Routing Overhead In Mobile Ad-hoc Networks

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Abstract: A mobile ad hoc network is an autonomous collection of mobile devices (laptops, smart phones, sensors, etc.) that communicate with each other over wireless links and cooperates in a distributed manner in order to provide the necessary network functionality in the absence of a fixed infrastructure. As the topology of MANET is dynamic, there exist recurrent link breakages which lead to path failures and route discoveries. For data dissemination, broadcasting is the fruitful method which follows the first received route request packet which results in serious redundancy, contention and collision known as broadcast storm problem. To overcome this problem in this project a neighbor coverage probabilistic rebroadcast protocol is used. By using the concepts of coverage ratio and connectivity factor a reasonable rebroadcast probability is generated which improves the routing performance.

Keywords: MANET, Broadcasting, Data Dissemination, Coverage ratio, Connectivity factor.

I. INTRODUCTION

In mobile ad-hoc network consists of collection of all mobile nodes without any fixed infrastructure. In this we have different routing protocols such as reactive, proactive, hybrid. All the reactive routing protocols AODV, DSR, TORA used to establish route between source and destination. Due to mobility in mobile ad-hoc networks a destination may from one position to another position. But the source node keeps on sending control packets to the destination via all the nodes in network until to establish a route between source and destination. Among all the reactive routing protocols AODV is a best routing protocol which establish a route based on demand. Due to absence of routing tables it occupies less amount of memory. In ad-hoc networks every node acts as a router which is able to transfer information to different nodes. This creates some issues, beside the issues of dynamic topology that is unpredictable property changes.

1.1 Characteristics:

- Infrastructure less
- Power limitation
- Dynamic topologies
- Self-Configuring
- No centralized controller
- Light weight teriminals.

1.2 Applications:

- Military battlefield
- Sensor Networks
- Disaster Area Network
- Personal Area Network

Fig.1 Mobile ad-hoc network

II. Related Work

J. Kim, Q. Zhang, and D.P. Agrawal, proposed a dynamic probabilistic broadcasting approach with coverage area and neighbor confirmation. Here author adjusted the rebroadcast probability of a node with the help of coverage area concept. [2]

H. AlAamri, M. Abolhasan, and T. Wysocki, proposed a new routing protocol for Ad hoc networks, call it as On-demand Tree-based Routing Protocol (OTRP).In this protocol to improve the scalability of ad-hoc networks Tree-based Optimised Flooding algorithm used, which contains knowledge of hop-by-hop routing such as AODV. When there is no previous knowledge about destination. [3]

S.Y. Ni, Y.C. Tseng, Y.S. Chen, and J.P. Sheu, proposed mobile Ad-hoc networks broadcasting is a best method for finding route between source and destination. Due to characteristic of node mobility in a MANET frequent link breakages occur, because of link breakages broadcasting technique is re-applied. By applying broadcasting many no of times which results in serious redundancy, contention and collision is known as broadcast storm problem. [4]

X. Wu, H. R. Sadjadpour, and J. J. Garcia-Luna-Aceves, proposed a mathematical framework for quantifying the overhead of proactive routing protocols in mobile ad hoc networks (MANETs). This framework is useful to calculate Euclidean distance, when the nodes are moving randomly. [5]

III. Existing System

One of the fundamental challenges in the MANET is to propose new routing protocol with less routing overhead. All the present routing protocols first establish a route between source and destination in order to transfer data within the networks. To establish a route most of the networks use flooding concept (AODV). Due to flooding, redundant retransmissions (RREQ) increases in the network which leads to increase routing overhead. Because of routing overhead, collisions, contentions and path failures is known as broadcast storm problem.

3.1 Disadvantages of AODV protocol

- Broadcast Storm Problem.
- Packet loss increases.

- Packet delivery ratio decreases.
- Routing overhead increases.
- Transferring of packets not takes place in required interval of time.

3.2 Broadcast storm problem

Broadcasting is a best technique for data transmission between source and destination. The AODV protocol uses flooding to discover a route between source and destination. i.e. each node in the network blindly rebroadcast to all nodes in the network, which leads to increase the RREQ packets. Due to increase of RREQ packets in the network causes collision, contention called as Broadcast storm problem.

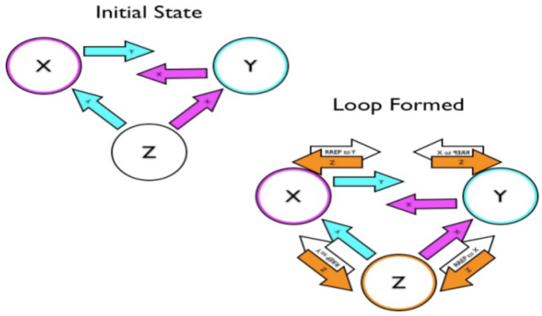

Fig. 2 Broadcast storm problem

IV. PROPOSED SYSTEM

In this section we are discussing how to calculate rebroadcast delay and rebroadcast probability of the NCPR protocol, which is based on neighbor analysis. NCPR protocol has been proposed for reducing the routing overhead in highly dynamic network. Other protocols like AODV and DSR have been proposed for MANET and they improve the scalability of MANET but due to high mobility of node in MANET they are limited. We have proposed PR protocol to improve the performance of node in high dynamic and heavy loaded traffic network.

4.1 Calculation of Uncovered Neighbors Set and Rebroadcast Delay.

Whenever source s sends RREQ packet to its neighbor node n_i, based on neighbors list available in the RREQ packet the node n_i identifies how many neighbors uncovered by the RREQ packet which has been delivered from node s. the number of uncovered neighbors are more for node n_i with s. then obviously node n_i rebroadcast RREQ packet, this reach more neighbors. We calculate the uncovered neighbor set of node U(ni) of node ni as follows. .

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

Then we get the initial UCN set. Because of broadcasting property of RREQ packet node n_i may receive duplicate RREQ packets from its neighbors. Based on neighbor knowledge the node ni further adjust the U(ni). Here N(s) and N(ni) are represents neighbor sets of node s and n_i respectively. The rebroadcast delay T_d (n_i) of node ni is calculated as follows:

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

$$T_d(n_i) = MaxDelay \times T_p(n_i)$$

Here delay ratio of node n_i can be obtained from $T_p(n_i)$. is the weight ratio of node n_i and Max Delay is the negligible delay.

4.2 Calculation of Neighbor Knowledge and Rebroadcast Probability:

Due to broadcast property node n_i gets a extra RREQ packet from its neighbor n_j then node ni can further adapt its UCN set according to the neighbor list in the RREQ packet from n_j. Then $U(n_i)$ is determined as follows

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

After adopting the $U(n_i)$, the RREQ packet received from n_j is discontinued. The combination additional coverage ratio and connectivity factor determines rebroadcast probability. Here $Ra(n_i)$ is the additional coverage ratio of node n_i can be determined as follows

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

The above formula represents ratio between extra covered nodes by this rebroadcast to the total number of neighbors of node n_i The connectivity factor $F_c(n_i)$ is defined as follows

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

Where Nc=5.1774 log n, and n is the number of nodes in the network. The rebroadcast probability Here $pre(n_i)$ is the rebroadcast probability of a node n_i is represented as follows

$$P_{re}(n_i) = F_C(N_i) \times R_a(n_i)$$

Where if the $p_{re}(n_i)$ is greater than 1, we set $p_{re}(n_i)$ to 1.

V. PROTOCOL IMPLEMENTATION

To implement our proposed protocol we had used NETWORK SIMULATOR VERSION-2. We have taken source code of AODV and modified based on functionality of NCPR protocol. To identify the information about neighbors NCPR protocol requires HELLO packets, and also RREQ packet requires carrying neighbor list. The proposed protocol reduces maximum number of Hello packets and neighbor list in RREQ packet [1]. We have used following simulation parameters for calculating performance of our proposed protocol.

TABLE I: Simulation Parameters

Simulation parameters	Value
Simulator	NS-2(v.2.34)
Topology Size	1000m X 1000m
Number of nodes	20
Traffic Type	CBR
Transmission Range	250m
Bandwidth	2MBPS
Interface Queue Length	50
Number of CBR Connections	8,10,12,15
Packet Size	512 bytes
Packet Rate	4 Packets/sec
Pause Time	0sec
Min Speed	1m/sec
Max Speed	5m/sec

VI. PERFORMANCE EVALUATIONS

By using NCPR protocol we reduced the packet lost, end to end delay and increases packet delivery ratio, received data packets**.**

6.1 Packet delivery ratio:

The ratio of number of data packets received by the destination to the number of packets generated by the sources. It can represent mathematically by the following way

PDR=S1/S2;

Where S1 represents total number of data packets received by each destination.S2 represents total number of data packets generated by each source. In NCPR protocol packet delivery ratio increased by reducing the routing overhead.

6.2 End to end delay:

Delay is the difference between the time at which the sender generated the packet and the time at which the receiver received the packet. Mathematically we represent the following way.

Average end to end delay= S/N

Here S represents sum of time spent to deliver packets to each destination. The N represents number of packets received by all destinations.

6.3 Packet lost:

Packet lost is calculated by the difference between number of data packets send by the source and number of data packets received by the destination.

Packet lost=number of sent packets-number of received packets.

VII. RESULTS

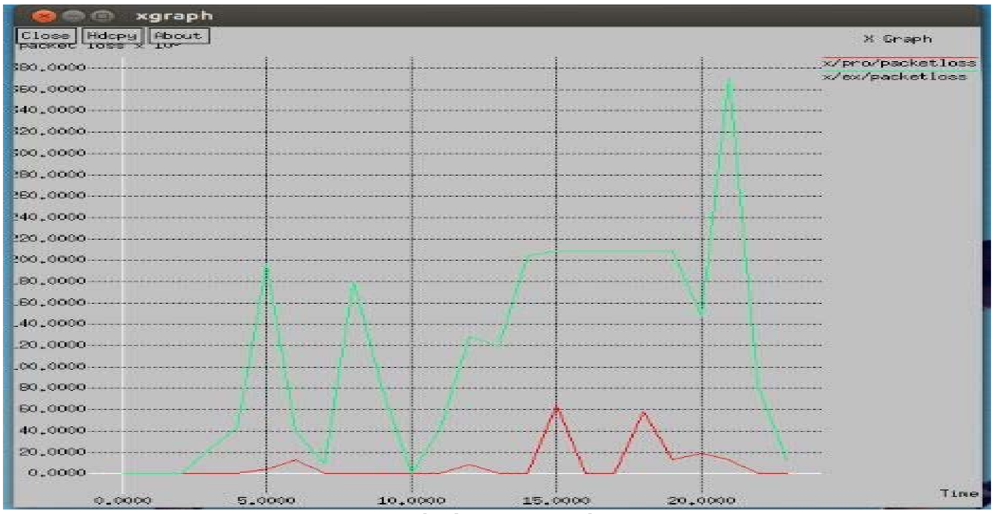

Fig.4 Packet lost varying with time.

Figure 4 represents packet lost varying with time. In this X-axis represents time and Y-axis represents packet lost. we have represented AODV protocol with green lines and NCPR protocol represents red lines. The proposed NCPR protocol reduces packet lost by reducing the collisions in the network.

Fig. 5 Received data packets varying with time.

Figure 5 represents number of data packets varying with time. In the graph X-axis represents time and Y-axis represents received data packets. We have represented red lines for NCPR protocol and green lines AODV protocol. The proposed NCPR protocol increases number of received data packets due to decrease in the redundant rebroadcasts.

Fig. 7 Routing overhead varying with time

Figure 6 represents routing overhead varying with time. In this X-axis represents time and Y-axis represents routing overhead. We have represented green lines for AODV protocol and red lines for NCPR protocol. The proposed NCPR protocol reduces routing overhead.

VIII. CONCLUSION

In this paper we have seen performance analysis of AODV and NCPR routing protocols. The proposed NCPR protocol is used for reducing the routing overhead in mobile ad-hoc networks. It contains additional coverage ratio and connectivity factor. We used rebroadcast delay for determining data transmission order. Due to avoiding flooding in NCPR protocol causes to reduce routing overhead. When network is large, NCPR protocol increases the packet delivery ratio, decreases the end to end delay, packet lost when compared to the AODV protocol. According to simulation results NCPR protocol has good performance compared to AODV protocol. In future we implement DSR routing protocol and compare with NCPR protocol.

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