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Spatial Distribution Adaptive Protocol for Multicast Routing in MANET

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***Abstract*—Mobile ad-hoc network is an important and emerging application of wireless systems. Number of applications are developed on broadcast communications, so efficient routing methods are critical for their success. Blindly retransmitting broadcast packets can lead to an explosive growth of traffic called the Flooding and looping problem that attenuates broadcast performance as a result of collisions and congestion. A major design issue for an efficient and effective routing protocol for MANETs is to achieve optimum values of performance parameters under network different scenarios where nodes are subjected to different types of mobility that dynamically change the network topology. In this paper the Distribution-Adaptive Distance with Channel Quality (DADCQ) protocol used and designed to tackle various multicast problems and shown some simulation results that it performs well compared to several existing multihop broadcast proposals. DADCQ protocol performs better than several existing broadcast protocols by using distance method and adaptive decision threshold value.**

***Keywords*- MANET, DADCQ, flooding, adaptive decision threshold value**

I. INTRODUCTION

Connection of wireless mobile nodes which dynamically forming a temporary network without use of any centralized control or fixed network infrastructure called as Mobile Ad Hoc Network. While transmitting and receiving data Flooding and looping can occure.[1] Multicasting plays an important role in ad hoc networks when the applications must send the same data to more than one destination. While multicasting provides the bandwidth efficiency, reduced delays and high scalability, it constructed multicast trees primarily based on connectivity which may be unsatisfactory when QoS is considered. This is because of the lack of resources. QoS is more difficult to give the guarantee in ad hoc networks than in other type of networks, due to the wireless bandwidth is shared among adjacent nodes and the network topology changes as the nodes move [2].

Broadcasting is a fundamental operation in all kinds of networks; it may be used for discovering neighbors, collecting global information, naming, addressing, and sometimes helping in multicasting [3]. Research in this area has demonstrated that blindly retransmitting broadcast packets (flooding) can lead to an explosive growth of traffic called the broadcast storm problem, that attenuates broadcast performance as a result of collisions and congestion [4].So there is need of some efficient adaptive protocols to solve broadcast storm problem. The proposed DADCQ protocol is adaptive which shows high efficiency while achieving desired reachability. Designing of the proper threshold value is key factor for efficiency and high reachability. Aggressive threshold value will give low coverage. but more conservative value also causes low broadcast efficiency. For best efficiency and reachability the optimal threshold value must be found [4]. An optimal value varies with spatial distribution pattern, node density, and wireless channel quality. The main objective of this work to demonstrate how threshold function that is adaptive to a wide range of various scenarios and achieves both efficiency and reachability.

II. RELATED WORK

Multiple protocols are proposed to minimize the multicast flooding and looping is called broadcast storm.

The double covered based scheme (DCB) is sensitive to the node’s mobility [5] Both double coverage mechanism increases the delivery ratio when the transmission error rate is high, but increasing the number of retries only slightly improves or even decreases the delivery ratio.[5], And also when the node's mobility increases the delivery ratio of the DCB drops significantly. The reason is high mobility of nodes makes node neighbor sets outdated quickly.[6] DCB algorithm is applicable only to discover routes to the destination node, not for data delivery. And it does not discuss about route failures and their maintenances [7].The reachability per covered node is higher so the rebroadcasting is not needed. And the reachability in both urban and highway scenario is very low so it is not giving optimal efficiency.

p-Persistence neighbor discovery gives better performance with an increasing number of neighbors than existing protocols, and it has guarantee the discovery of all neighbors, even in a multi-hop environment with a simple check process under a fixed frame size but its bacon interval is disable, reachability per covered node is low so rebroadcasting takes many times[8].

III. REVIEW OF BROADCASTING SCHEMES

Review of four representative schemes: location-based scheme, Double- Covered Broadcast protocol, counter-based scheme and DADCQ Protocol for minimizing broadcast storm problem.

A. p-PERSISTENCE

The first protocol is use for comparison is persistence, The basic broadcast techniques follow either a 1-persistence or a p-persistence rule. In this method, transmitter station that wants to transmit data continuously sense the Channel to check whether the channel is idle or busy. This method has the highest chance of collision because two or more station may find channel to be idle at the same time and transmit their frames. The excessive overhead, most routing protocols designed for multi-hop ad hoc wireless networks follow the brute-force 1-persistence flooding rule which requires that all nodes rebroadcast the packet with probability 1 because of the low complexity and high packet penetration rate. This approach is sometimes referred to as probabilistic flooding. The slotted p-persistence scheme can substantially reduce the packet loss ratio at the expense of a slight increase in total delay and reduced penetration rate[9].

B. DOUBLE-COVERED BROADCAST PROTOCOL

A broadcast operation requires the packet disseminated to all nodes in the network. But the interference of the transmission of neighbors and the movement of the nodes may cause the failure of some nodes to receive the broadcast data packet. The broadcast efficiency can provide more chance for a node to successfully receive the packet. The double-covered broadcast algorithm uses following scheme :- When a sender broadcasts a packet, it selects a subset of I-hop neighbors as its forward nodes to broadcast based on a greedy algorithm to find shortest path. The selected forward nodes satisfy two conditions: (a) They cover all the nodes within 2 hops of the sender. (b) The sender's 1-hop neighbors are either forward nodes or non-forward nodes but covered by at least two neighbors, once by the sender itself and once by one of the selected forward nodes. After receiving the broadcast data packet, each forward node save the records of the that data packet and computes its forward nodes and re-broadcasts the data packet to a new sender node. As the acknowledgement of receiving the data packet, the retransmissions of the forward nodes are received by the sender. Receipt of the broadcast do not acknowledge by the non-forward 1-hop neighbors of the sender. To overhear the rebroadcasting from its forward nodes, the sender waits for a specified duration. If the sender fails to detect all its forward nodes retransmitting during this duration, it assumes that a transmission failure has occurred for this broadcast because of the transmission error or because the missed forward nodes are out of its transmission range. The packet will be re-send by the sender, until all forward nodes are retransmitted or the maximum number of retries is reached. The algorithm utilizes the method that the sender overhears the retransmission of the forward nodes to avoid the ACK implosion problem. The algorithm also guarantees that each node is covered by at least two transmissions so that it can avoid a single error due to the transmission collision. Moreover, the algorithm does not suffer the disadvantage of the receiver-initiated approach that needs a much longer delay to detect a missed packet [6]. The DCB algorithm selects a set of forwarding nodes that form a virtual backbone of the network. The forwarding nodes are selected in such a way that they balance the average retransmission redundancy for the delivery of a broadcast packet throughout the entire network. The scheme avoids the broadcast storm problem: Since only the forwarding nodes transmit the packet, the broadcast collision and congestion are both reduced. This scheme also avoids the ACK implosion problem: The retransmissions of forwarding nodes are also used as the ACKs to the sender so that no extra ACKs are needed. Overhearing of forwarding nodes failure' relays will trigger the sender to retransmit the packet, for the packet loss can be recovered in a local region. Each non forwarding node is covered by at least two forwarding neighbors so that it can tolerate a single transmission error and its chance to receive the broadcast packet successfully is greatly increased even in a high transmission error rate environment. The algorithm does not suffer the disadvantage of the receiver-initiated approach that needs a much longer delay to detect a missed packet[5].

C. DADCQ

Distribution adaptive distance with channel quality (DADCQ) protocol is used to design a statistical protocol, for high efficiency while achieving desired reachability. The aim is the designing of the automatic adaptive threshold value function. The protocol will give low coverage if the threshold value is too aggressive, and if it is too conservative, the broadcast efficiency will be low. The optimal value of the threshold will be found that gives the best efficiency and possible reachability. DADCQ protocol utilizes the distance method to select forwarding nodes. This protocol helps in achieving high reach-ability and low bandwidth consumption in urban and highway scenarios with varying node density and fading intensity. The primary contribution of this work is the proposed multihop broadcast protocol DADCQ. The DADCQ combines node density , local spatial distribution information and other factors with the distance method to select rebroadcasting nodes.

The optimal value of the threshold function will varies with channel quality, node density, and distribution pattern. A main objective of this DADCQ protocol is to demonstrate how to design a threshold function that is adaptive to a wide range of these factors. This adaptive threshold function is then used in the proposed DADCQ protocol.

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The primary contribution of this work is the proposed multihop broadcast protocol DADCQ. DADCQ combines information about local spatial distribution and other factors with the distance method heuristic to select rebroadcasting nodes. Less comprehensive supplemental information is used in previous broadcast protocols proposed for ad hoc that make use of the distance method. Here described a methodology for incorporating more information into the protocol. With the use of this extra information, the protocols make adaptive to more networking scenarios than many previous proposals.

Distance Method: The proposed DADCQ protocol utilizes the distance method to select forwarding nodes. The distance method uses the minimum distance from sender to receiver (one-hop distance) as the discriminatory statistic between re broadcasters and non rebroadcasts. The method follows that if a node has received a message from another node very close to it, there is little benefit in terms of additional coverage achieved by rebroadcasting. Nodes then should favor rebroadcasting when this distance is large. The algorithm is simple and is given here.

1. Initialize $D = 1$.
2. When a message is received, set d to the distance to the sender, $D = \min(D, d/r)$, and perform a RAD (Random Assessment Delay)
3. When the RAD expires, rebroadcast if $D > Dc = f(N)$

Where Dc is critical distance value. And N is the node density. Now Dc can be find as,

$$D_c(N)=D_{max} - \beta e^{\alpha N}$$

Where Dmax, α, β, depends on external factors such as node distribution pattern and channel quality.

Adaptive threshold function design: It gives a novel design strategy for a decision threshold function. Threshold values are a critical component of many multihop broadcasting methods, such as stochastic broadcast (gossiping), the counter method, the distance method, and the location method [3]. The proposed design scheme builds a threshold function using three independent input variables chosen to allow the threshold to be adaptive to the environmental conditions of primary interest. All these variables calculate node density, the spatial distribution pattern of nearby nodes, and the wireless channel quality. The resulting threshold value of these three variables causes the protocol to operate efficiently across a broad range of scenarios.

Quadrant method for spatial distribution characterization: The local node distribution pattern is used to compute the rebroadcasting decision threshold in DADCQ. So the quadrant method of spatial statistics be used to characterize the spatial distribution of nodes for use in a multihop broadcast protocol. This contribution may be applicable in a wider context as well because distribution pattern may affect the behavior of many multihop broadcast methods.It should be 1D or 2D uniform or random.

IV SIMULATION RESULTS

In this section , the shortest distance calculation and packet delivery in different three paths shows. The distance method in which it calculates the shortest distance in between source to destination shows in MATLAB. When the user gives the source and destination the number of iterations will takes place to find the shortest path. Some snapshot are given below. If source ID and destination ID is mentioned under the scenario of mobile nodes are randomly separated , then the iterations shows for finding shortest distance.

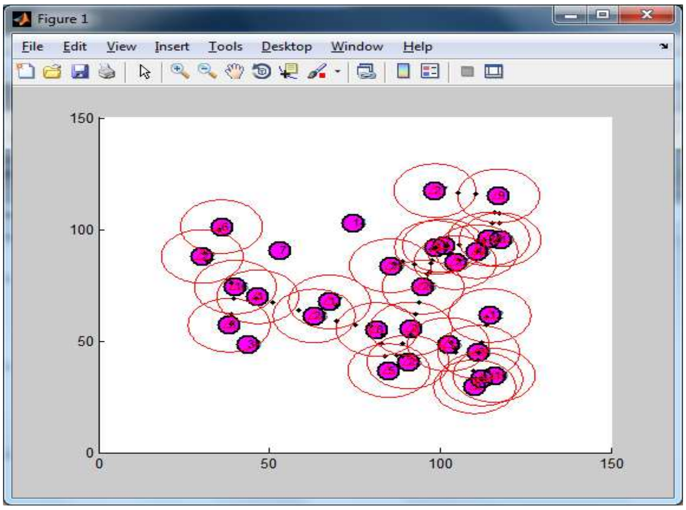

Fig.1 Sample continuum percolation

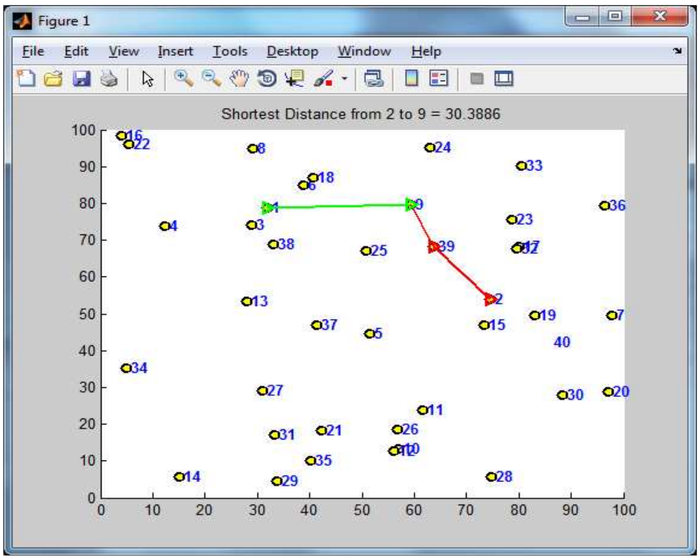

Fig.2 calculation of shortest distance

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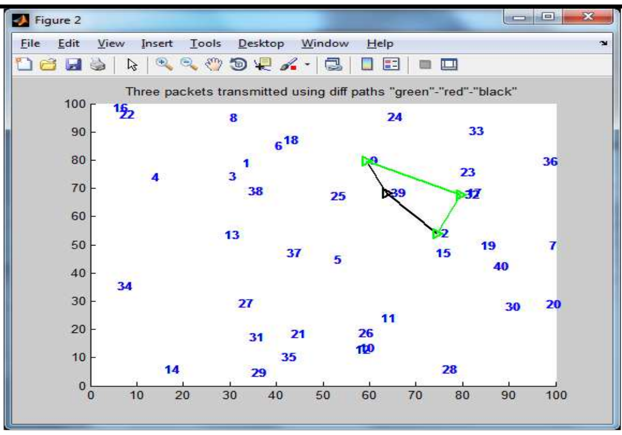
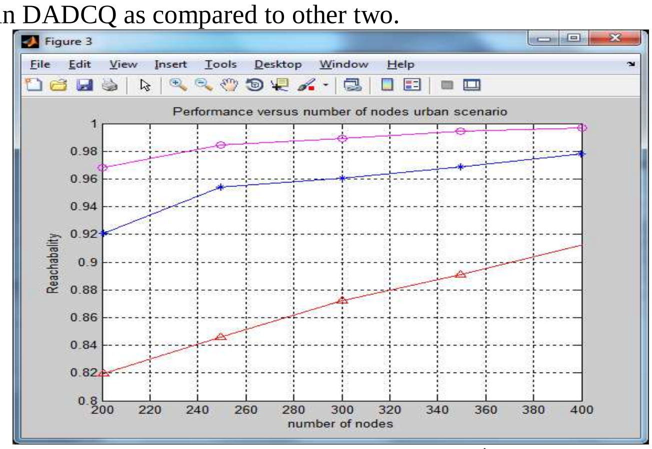


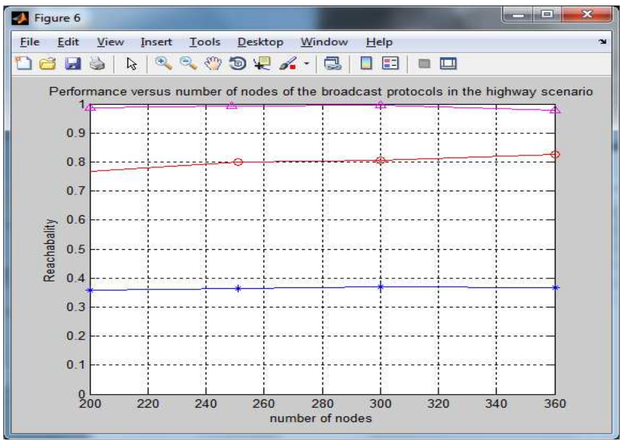
Fig.3 Different paths for Packet Delivery

The comparative study of existing protocol p-persistence, DCB, and proposed DADCQ protocol. In the urban and highway scenario the reachability of DADCQ protocol is high than p-persistence, DCB. The bandwidth consumption is less in DADCQ as compared to other two.



DADCQ o , p-persistence + , DCB △

Fig.4 Performance versus number of nodes urban scenario



DADCQ△ , p-persistence +, DCB o

Fig.5.Performance versus number of nodes of the broadcast protocols in highway scenario

CONCLUSION

The proposed DADCQ protocol is designed for multihop broadcasting in MANET. Efficient broadcasting, reachability and quality of service invariably depend on adaptive threshold value for routing. This paper compares few broadcasting protocols with newest protocol introduced for multicast that is DADCQ, in which the simulation results shows the DADCQ protocol gives high reach-ability and low bandwidth consumption by adaptive approach for threshold value.

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