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RESEARCH ARTICLE

Impact of Node Velocity and Density on Probabilistic Flooding and its Effectiveness in MANET

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Abstract- In recent year wireless network become more popular due to growth of mobile devices. The fundamental data dissemination mechanism in mobile ad hoc network (MANET) is broadcasting. However, broadcasting mechanism brings severe performance degradation in network due to its excessive redundant retransmission, collision, and contention. Traditionally flooding techniques was used as popular broadcasting techniques. But it generates large number of rebroadcast messages in order to reach all network nodes. Probabilistic flooding techniques have been suggested to reduce excessive redundant transmission. In this paper, we investigate the effect of node velocity, pause time and network density in the performance of probabilistic flooding techniques in MANET with respect to saved rebroadcast (SRB), rechability (RE) and success rate(SR) using NS2 simulator. Our result shows that all these parameter have strong impact on the probabilistic techniques.

Keywords: Velocity, Density, Flooding, Broadcasting, Success rate, NS2

I. INTRODUCTION

MANET forms a random network by consisting of mobile nodes which communicates over wireless path. This kind of network is more appropriate where networking infrastructure is not available and set up time is very less and temporary network connectivity is required. The distributed, wireless, and self-configuring nature of MANETs make them suitable for a wide variety of applications [1]. In on demand distance vector routing protocol, in order to send the packet the source node initiates RREQ packet and broadcast to its neighbors to discover the route. The broadcasting is referred as flooding (or blind flooding). The blind flooding causes unnecessary collision and bandwidth waste. For this problem some optimization techniques applied. The flooding can be classified into simple or blind flooding, probability based flooding, area based flooding and neighbor knowledge methods. The neighbor knowledge based flooding further classified into clustering based flooding, selecting forwarding neighbors and internal node based flooding. A straightforward flooding is very costly and will result serious redundancy, contention and collision. They identified this broadcast storm problem. Recently, probabilistic broadcast schemes for MANETs have been suggested for broadcast storm problem [2][3] associated with the simple flooding.

The rest of the paper is structured as follows. Section II explains the related work. Section III will describe routing protocol and section IV will present broadcasting techniques. Section V will present simulation set up and section VI will explain result and analysis. Finally, we conclude our work in section VII.

II. RELATED WORK

One of the earliest broadcast mechanisms in both wired and wireless networks is flooding, where every node in the network retransmits a message to its neighbors upon receiving it for the first time. Although flooding is simple and easy to implement, it can be costly in terms of network performance, and may lead to a serious problem, often known as the *broadcast storm problem* [2][3][4] which is characterized by high redundant message retransmissions, network bandwidth contention and collision. Ni, T [3] has studied the flooding protocol analytically and experimentally. Their obtained results have indicated that rebroadcast could provide at most 61% additional coverage and only 41% additional coverage in average over that already covered by the previous broadcast attempt. As a result, they have concluded that rebroadcasts are very costly and should be used with caution. The authors in [5] have also classified existing broadcasting schemes into five categories with respects to their ability to reduce redundancy, contention, and collision. The categories include probabilistic, counter based, distance-based, location-based and cluster-based. In the probabilistic scheme, a mobile node rebroadcasts messages according to a certain probability. In the counter-based scheme, a node determines whether to rebroadcast a message or not by counting how many identical messages, it has received during a random time period.

III. ROUTING PROTOCOLS IN MANET

Dynamic nature of MANET makes the routing complicated and route failure occurs frequently. So node mobility is main source of route failures in wireless network. In addition to node mobility, channel contention may be the other reason of route failure. Routing protocols of MANET broadly classified in two different categories based on how they discover the route. One is proactive protocols and another is reactive protocols.

A. Destination-Sequenced Distance-Vector

It is a proactive routing protocol whose routing method based on the Bellman-Ford algorithm [6]. Each node maintains a routing table to keep distance information to other node. The routing table is updated when there is a change of network topology and informed other nodes periodically about the change. Each entry has sequence number to indicate its freshness and loop free. Also it helps to mark stale route. The sequence number is incremented by a node after sending each message to other.

B. Ad Hoc On- Demand Distance Vector

It is a reactive routing protocol which discovers route on demand when a packet needs to be sending by a source [7]. Route discovery process starts by sending route request (RREQ) packet to their neighbors. Then neighbor forward the RREQ to their neighbor and so on. This sending process is continued by every neighbor node until the destination gets the message or they have a route to destination. On either case nodes reply back with a route reply (RREP) message. In case of route breakage the intermediate node discover another new route or send a route error (RERR) message to the source. Upon receiving RERR the source node tries to get new route by invoking again route discovery process.

IV. BROADCASTING TECHNIQUES

Broadcasting refers to a method of transferring a message to all recipients simultaneously. Broadcasting can be performed as a high level operation in a program, for example broadcasting Message Passing Interface, or it may be a low level networking operation, for example broadcasting on Ethernet. Network wide broadcasting, simply referred to as “broadcasting”, is the process in which one node sends a packet to all other nodes in the network. Broadcasting may be used to disseminate data to all other nodes in the network or may be used by MANET unicast or multicast routing protocols to disseminate control information.

A. Simple Flooding

In this method[4], a source node of a MANET disseminates a message to all its neighbors, each of these neighbors will check if they have seen this message before , if yes the message will be dropped, if not the message will re-disseminated at once to all their neighbors. The process goes on until all nodes have the message. Blind flooding ensures the coverage; the broadcast packet is guaranteed to be received by every node in the network.

B. Probabilistic Flooding

The Probabilistic scheme [5] from is similar to Flooding, except that nodes only rebroadcast with a predetermined probability. In dense networks multiple nodes share similar transmission coverage. Thus, randomly having some nodes not rebroadcast saves node and network resources without harming delivery effectiveness. In sparse networks, there is much less shared coverage; thus, nodes won't receive all the broadcast packets with the Probabilistic scheme unless the probability parameter is high. When the probability is 100%, this scheme is identical to Flooding.

C. Area-based Method

Suppose a node receives a packet from a sender that is located only one meter away. If the receiving node rebroadcasts, the additional area covered by the retransmission is quite low. On the other extreme, if a node is located at the boundary of the sender node's transmission distance, then a rebroadcast would reach significant additional area, 61% to be precise [8][9]. A node using an Area Based Method can evaluate additional coverage area based on all received redundant transmissions. We note that area based methods only consider the coverage area of a transmission; they don't consider whether nodes exist within that area.

D. Counter-based Method

S.-Y. Ni, Y.-C. Tseng [2][3] show an inverse relationship between the number of times a packet is received at a node and the probability of that node being able to reach additional area on a rebroadcast. This result is the basis of their Counter-Based scheme. Upon reception of a previously unseen packet, the node initiates a counter with a value of one and sets a RDT (which is randomly chosen between 0 and T max seconds). During the RDT, the counter is incremented by one for each redundant packet received. If the counter is less than a threshold value when the RDT expires, the packet is rebroadcast. Otherwise, it is simply dropped. From [2], threshold values above six relate to little additional coverage area being reached.

V. SIMULATION SET UP

We study the performance of Probabilistic flooding protocol in MANET with respect to three metrics such as throughput, packet delivery ratio and packet loss. We evaluate the performance of these protocols using NS2 simulator [10].

A. Simulation tool and Parameter

We create a random topology of different node sizes which varies from 20 to 100. Each node moves with V_{max} speed with in 1000m x 1000 m area based on random way point mobility model[11]. In this mobility model, nodes that follow a motion-pause recurring mobility state, where each node at the beginning of the simulation remains stationary for pause time seconds, then chooses a random destination and starts moving towards it with speed selected from a uniform distribution (0, max speed]. After the node reaches that destination, it again stands still for a pause time interval (pause time) and picks up a new destination and speed. This cycle repeats until the simulation terminates. Other parameter used for our simulations are shown in table 1.

TABLE 1
PARAMETER FOR SIMULATION

PARAMETER	***VALUE***	***PARAMETER***	***VALUE***
Channel type	Wireless channel	Node Speed	1, 5, 10, 15 m/s
MAC	802.11	Pause Time	0,10,20sec
Routing Protocol	AODV	Number of nodes	20, 40, 60, 80, 100
Mobility Model	Random Way Point	Transmission Range	250 m
Propagation Model	Two Ray Ground	IFQ Length	150
Packet type	FTP	Topography	1000 m X 1000m
Packet Size	of 512 Bytes	Time of simulation	100 Sec

B. Performance Metrics

In order to evaluate the performance of the probabilistic flooding in wireless Mobile ad-hoc network we consider three important metrics that could greatly impact on the performance of the MANET.

- **Reachability (RE)** – This is the percentage of nodes that received the Broadcast message to the total number of nodes in the network.
- **Saved Rebroadcast (SRB)** – This is the percentage of nodes that have received but not rebroadcast the message. Thus, SRB is defined as ((r – t)/r)*100, where r and t are the number of nodes that received the broadcast message and the number of nodes that transmitted the message respectively.
- **Success rate**- Average received message per node/total broadcast message

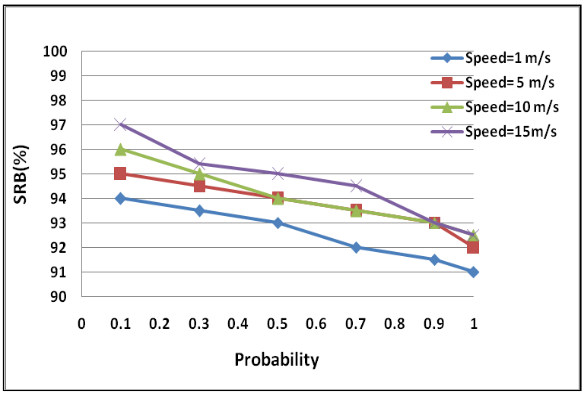
VI. RESULT AND ANALYSIS

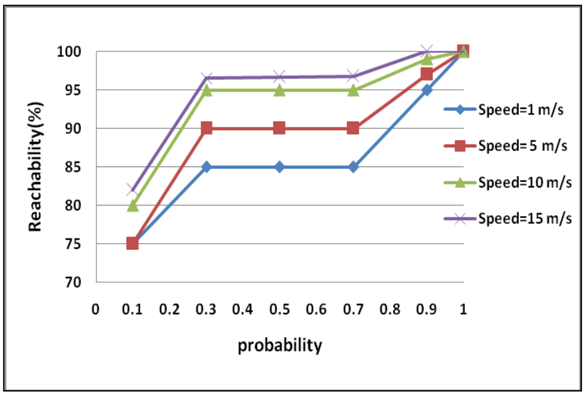
In this section, we present the results gathered from the simulation experiments from various scenarios. In section 1, we investigate the impact of node speed (velocity), pause time and node density on the performance of flooding protocol. In section we compare the flooding protocol with blind flossing protocol.

A. *Impact of Node Speed, Node Density and Pause Time on Probabilistic Flooding*

Initially we measured the saved rebroadcast and rechability of probabilistic flooding techniques for different node speed 1, 5, 10, 15 meter/sec. The probability for rebroadcasting is from 0.1 to 1 as shown in figure 1. As figure suggests the saved rebroadcast and rechability increases for a node speed increases. In this, saved rebroadcast is highest for a node having speed 15 m/s. For each probability value, as the mean node speed increases the saved rebroadcast increases.

However the SRB decreases and RE increases with increased probability. As a result we can say the node speed (velocity) has critical impact on saved rebroadcast and rechability.





(a) (b)

Figure 1. Probabilistic flooding for different node speed (a) SRB Vs Probability (b) RE Vs Probability

Then we measured the success rate probabilistic techniques for different node speed over the range of rebroadcasting probability 01. to 1. From figure 2 the success rate is highest for a node having speed maximum i.e. 15 m/s. however success rate decreases with increased probability.

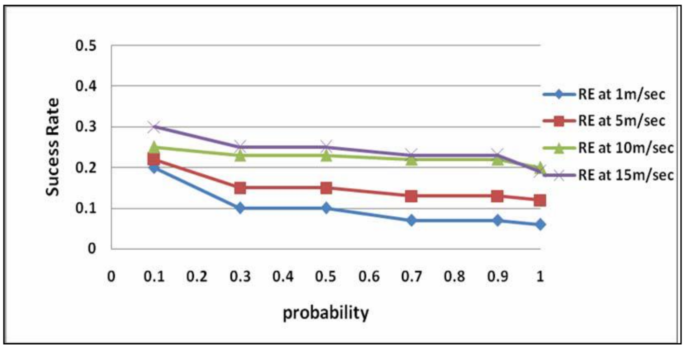
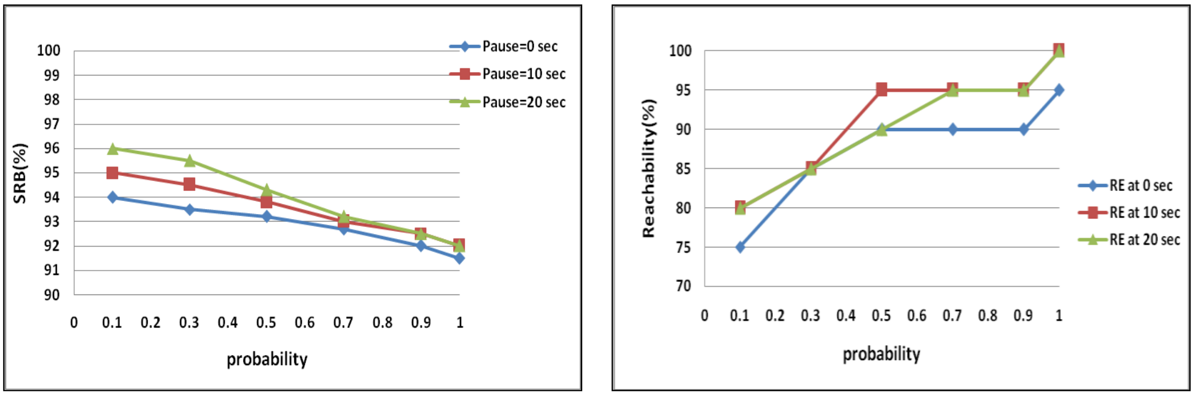


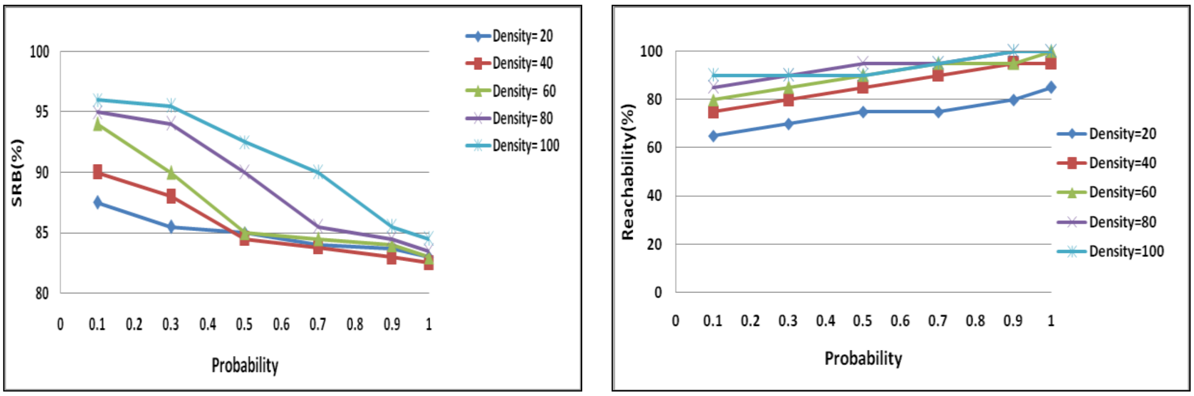
Figure 2. Success Rate Vs Probability for different node speed

Next we measured the saved rebroadcast and rechability of probabilistic flooding techniques for different pause time 0, 10, 20 sec. As shown in figure 3, the performances of probabilistic flooding with respect to SRB decreases with the increase of rebroadcasting probability. For continuous movement (pause time 0) the SRB is low as compared to non-continuous movement (pause time 10 or 20 sec). However the reachability of these techniques increases with increased probability and it is higher for higher pause time 20 sec.



(a) (b)

Figure 3. Probabilistic flooding for different pause time (a) SRB Vs Probability (b) RE Vs Probability



(a) (b)

Figure 4. Probabilistic flooding for different node Density (a) SRB Vs Probability (b) RE Vs Probability

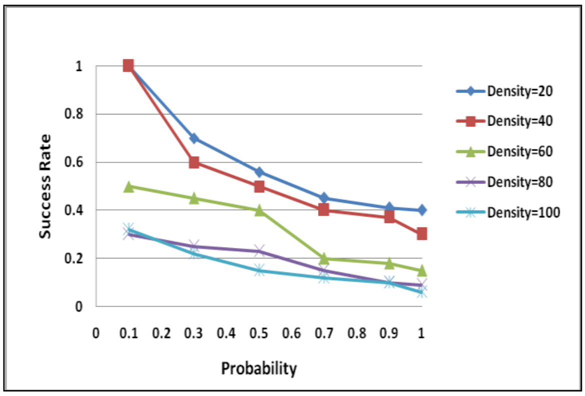
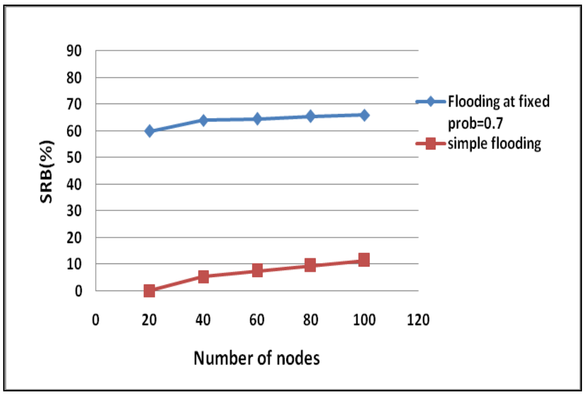


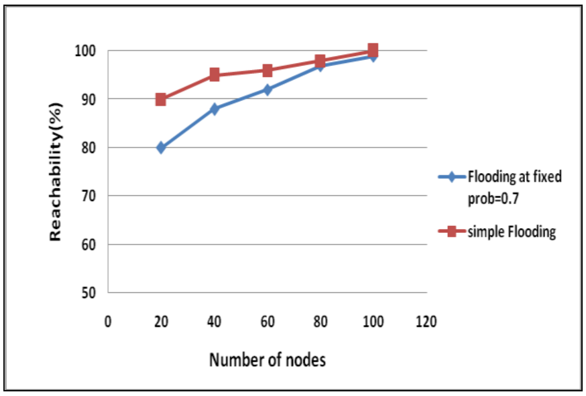
Figure 5. Success rate Vs probability for different node Density

B. Comparison of Simple Flooding With Probabilistic Flooding

As figure 9 suggests the saved rebroadcast of the fixed probabilistic flooding is around above 60% irrespective of the network density which is much higher than simple flooding. However in simple flooding the saved rebroadcast is around 10% irrespective of the network density. From figure 9 and 10 we conclude that SRB and RE increases with number of nodes. In the other way the reachability in network increase because of number of nodes increases.



(a)



(b)

Figure 6. Comparison of Simple flooding and Probabilistic flooding (a) SRB Vs Number of nodes (b) RE Vs Number of nodes

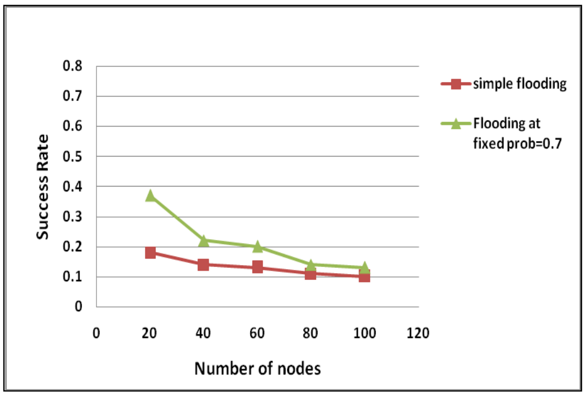


Figure 7. Success Rate Vs Number of nodes

VII. CONCLUSIONS

This paper explores the impact of node speed, node density and pause time on the performance of the probabilistic based flooding in Mobile Ad hoc Networks. Our results show that for different rebroadcast probabilities, as the node speed increases, reachability, success rate and saved rebroadcast increases. Moreover, as the pause time increases saved rebroadcast and Reachability also increases. Similar performance trends have been observed when the other important system parameter, notably node density have examined in that they have been found to have a great impact on the degree of Reachability, the number of saved rebroadcasts and Success Rate achieved by the probabilistic broadcasting scheme. Probabilistic based flooding achieved high SRB and success Rate than simple flooding. However simple flooding achieves high reachability than probabilistic schema. It is concluded that node mobility, node density and pause times have a substantial effect on the performance of probabilistic flooding techniques with respect to reachability, saved rebroadcast, success rate.

REFERENCES

[1] C-K. Toh, *Ad hoc mobile wireless networks: Protocols and systems*, Prentice-Hall, New York, 2002.
[2] S.-Y. Ni, Y.-C. Tseng, Y.-S. Chen, J.-P. Sheu, "The broadcast storm problem in a mobile ad hoc network", *Wireless Networks*, vol. 8, no. 2, pp.153-167, 2002.
[3] S.-Y. Ni, Y.-C. Tseng, Y.-S. Chen, J.-P. Sheu, "The broadcast storm problem in a mobile ad hoc network", in *Proc. Mobicom'99*, pp. 151-162, 999.
[4] B. Williams, T. Camp, "Comparison of broadcasting techniques for mobile ad hoc Networks", in *Proc. ACM Symposium on Mobile Ad Hoc Networking & Computing (MOBIHOC 2002)*, pp. 194–205, 2002.
[5] Y. Sasson, D. Cavin, A. Schiper, "Probabilistic broadcast for flooding in wireless mobile ad hoc networks", in *Proc. IEEE Wireless Communications & Networking Conference (WCNC 2003)*, pp. 1124-1130, March 2003.
[6] Ford Jr, L.R., Fulkerson, D.R.: *Flows in Networks*, Princeton Univ. Press, 1962.
[7] Perkins, C. E., Belding-Royer, E., Das, S.R..: Ad-hoc on-demand distance vector (AODV) routing, *IETF RFC 3561*, 2003.
[8] N.Karthikeyan, Dr.V.Palanisamy, and Dr.K.Duraiswamy , "Performance Comparison of Broadcasting methods in Mobile Ad Hoc Network" , *International Journal of Future Generation Communication and Networking*, Vol. 2, No. 2, June 2009.
[9] W. Peng and X. Lu. "Efficient Broadcast in Mobile Ad hoc Networks using Connected Dominating Sets", *Journal of Software*,1999.
[10] The Network Simulator Ns-2, [online] http://www.isi.edu/nanam/ns/.
[11] W. Navidi and T. Camp, "Stationary distributions for the random waypoint mobility Model", *IEEE Transactions on Mobile Computing*, vol. 3, no. 1, pp. 99-108, 2004.