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AN IMPROVED APPROACH IN FLOODING WITH PACKET REACHABILITY IN FSR (FISHEYE STATE ROUTING) PROTOCOL USING MANET

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ABSTRACT

Packet Reach ability and Broadcasting in Mobile Ad Hoc Networks (MANETs) is a fundamental data dissemination mechanism with a number of important applications, e.g., route discovery, address resolution. However broadcasting induces what is known as the ‘‘broadcast storm problem’’ which causes severe degradation in network performance due to excessive redundant re- transmission, collision, and contention. Broadcasting in MANETs has traditionally based on flooding, which simply swamps the network with large number of rebroadcast messages in order to reach all network nodes. Although probabilistic flooding has been one of the earliest suggested schemes to broadcasting, there has not been so far any attempt to analyze its performance behavior in a MANET environment. In an effort to fill this gap, this paper investigates using extensive NS-2 simulations the effects of a number of important system parameters in a typical MANET, including node speed, pause time, and node density on the performance of probabilistic flooding. The results reveal that most of these parameters have a critical impact on the reach ability and the number of saved rebroadcast messages achieved by probabilistic flooding.

Keywords: *MANET, FSR (Fisheye State Routing) Protocol, Broadcasting, Flooding Probability, Saved Broadcasting, Packet Reach Ability, Node Speed, Pause Time, Mobility, NS2.*

1. INTRODUCTION

Mobile Ad Hoc Networks (MANETs) consist of a set of wireless mobile nodes which communicate with one another without relying on any pre-existing infrastructure in the network. The distributed, wireless, and self-configuring nature of MANETs make them suitable for a wide variety of applications[1].These include critical military operations, rescue and law enforcement missions as well as and disaster recovery scenarios [2,3]. Other potential applications of MANETs are in data acquisition in hostile territories, virtual classrooms, and temporary local area networks.

Broadcasting is a fundamental operation in MANETs where by a source node transmits a message that is to be disseminated to all the nodes in the network. In the one-to-all model, transmission by each node can reach all nodes that are within its transmission radius, while in the one-to-one model, each transmission is directed towards only one neighbor using narrow beam directional antennas or separate frequencies for each node [4]. Broadcasting has often been studied in the literature mainly for the one-to-all model [5], and most of this study is devoted to this model; it is worth nothing that the one-to-many model can also be considered, where fixed or variable angular beam antennas could be used to reach several neighbors at once [6]. Broadcasting has many important uses and several protocols in MANETs assume the availability of an underlying broadcast service [4,7]. It is also used for route discovery in reactive protocols. For instance, a number of routing protocols such as Dynamic Source Routing (DSR) [8], Ad Hoc on Demand Distance Vector (AODV) [8]Zone Routing Protocol (ZRP)Fisheye State Routing (FSR) [9, 10], and Location Aided Routing (LAR) [11] use broadcasting or one of its derivatives to discover and establish routes. Broadcasting also serves as the last resort for other group communication operations such as multicast.

A probabilistic approach to flooding has been suggested in Fisheye State Routing (FSR) Protocol [5,12,14,22,23] as a means of reducing redundant rebroadcast messages and alleviating the detrimental effects of the broadcast storm problem. In the probabilistic scheme, when receiving a message for the first time, a node rebroadcasts the message with a pre-determined probability p; every node has the same probability to rebroadcast the message. When the probability is 100%, this scheme reduces to simple flooding. The studies of [12,14] have shown that probabilistic broadcast incurs significantly lower overhead compared to blind flooding while maintaining a high degree of propagation for the broad cast messages. However, when analyzing the performance of probabilistic flooding, these studies have not taken into consideration a number of important factors that could greatly impact the performance of a typical MANET. Such factors include node mobility, network density, and injected traffic load. In an effort to gain a deep understanding and clear insight into the behavior of probabilistic flooding in a MANET environment, this paper investigates the effects of mobility on the operation and effectiveness of probabilistic flooding. Two important metrics, notably reachability and saved rebroadcasts, are used to assess network performance. Moreover, the well-known random waypoint model [15, 16] is used to analyze through extensive simulations the impact of varying node pause probabilistic flooding times and speeds on the performance of. The effects of varying node density, i.e. the number of network nodes per unit area for a given transmission range, and varying the traffic load, i.e. the number of broadcast request injected into the network per second are also studied. The results presented below reveal that node speed, pause time, and density have a critical impact on the reachability achieved by probabilistic flooding, and also have great impact on the saved rebroadcast messages.

The rest of the paper is organized as follows. Section 2 provides an overview of previous work on broadcasting in MANETs. Section 3 briefly describes the Proposed work probabilistic flooding method . Section 4 presents the performance results and analysis of the behavior of the broadcasting algorithm and presents the simulation model and the parameters used in the experiments. Finally, Section 5 Shows the Simulation Results and Section 6 concludes by a recount of the obtained results and suggestions for future work.

2. RELATED WORK

In my previous research work, [20] the investigations was on the behavior of the Proactive Routing Protocol - Fisheye State Routing (FSR) in the Grid by analysis of various parameters. The Performance metrics that are used to evaluate routing protocols are Packet Delivery Ratio (PDR), Network Control Overhead, Normalized Overhead, Throughput and Average End to End Delay. Experimental results reveal that FSR is more efficient in Grid FSR in all QOS constraints. FSR can be used in all Resource critical environments. Grid Fisheye state routing (GFSR)consumes less bandwidth by restricting the propagation of routing control messages in paths formed by alternating gateways and neighbor heads, and allowing the gateways to selectively include routing table entries in their control messages. PDR and Throughput are 100% efficient in Simulation Results in NS2. A new approach to reduce flooding performance with the Fisheye State Routing (FSR) protocol using ns-2 network simulator under different performance metrics scenario in respect to Node Density, Speed and Pause-time.

G. P. Mario, M. Gerla and T.W. Chen, (2000) et.al, proposed that the FSR is a descendant of GSR [21]. In [22], the authors introduce a novel proactive (FSR), the notion of multi-level fisheye scope to reduce routing update overhead in large networks. Nodes exchange link state entries with their neighbors with a frequency which depends on distance to destination. From link state entries, nodes construct the topology map of the entire network and compute optimal routes. Simulation experiments show that FSR is simple, efficient and scalable routing solution in a mobile, ad hoc environment. Fig. 1 refers the Fisheye scope with different hops.
The following are the advantages of FSR.
* Simplicity
* Usage of up-to-date shortest routes
* Robustness to host mobility
* Exchange Partial Routing Update with neighbors

3. PROPOSED WORK

In the flooding scheme, every node retransmits to its neighbors as a response to every newly received message. The probability-based scheme is a simple way of controlling message floods. In that

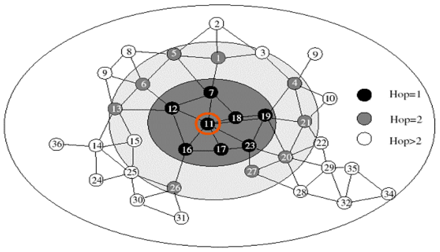

Fig. 1: Fisheye scope

each node rebroadcasts with a predefined probability p[12]. Obviously when p=1 this scheme resembles simple (blind) flooding. In the area based scheme, a node determines whether to rebroadcast a message or not by calculating and using its additional coverage area[5].The neighbor knowledge scheme [4] maintains neighbor node information to decide who should rebroadcast. To use the neighbor knowledge method, each node has to explicitly exchange neighborhood information among mobile hosts using periodic ‘‘hello’’ messages. The length of the period affects the performance of this scheme. Short periods could cause collision or contention while long periods may degrade the protocol’s ability to cope with mobility [18–20]. In this research work Random Waypoint Mobility Model (Bench Mark Mobility Model) is proposed. To Evaluate the performance of Packet Reach ability is considered with speed, Pause-time and Node Density with different levels. Saved Rebroadcast is also set to different levels.

3.1 Probabilistic Flooding in FSR

The simple flooding scheme [12] is a straight forward broadcasting approach that is easy to implement with guaranteed message dissemination. In this scheme, a source broadcasts messages to every neighbor who in turn rebroadcasts received messages to its neighbors and so on. This process continues until all reachable nodes have received and rebroadcast the message once. The probabilistic scheme [12] is one of the alternative approaches that aim at reducing redundancy through rebroadcast timing control in an attempt to alleviate the broadcast storm problem. In this scheme, when receiving a broadcast message for the first time, a node rebroadcasts the message with a pre-determined probability p so that every node has the same probability to rebroadcast the message, regardless of its number of neighbors. In dense networks, multiple nodes share similar transmission range. Therefore, these probabilities control the frequency of rebroadcasts and thus could save network resources without affecting delivery ratios.

It should be noticed that in sparse networks there is much less shared coverage, thus some nodes will not receive all the broadcast messages unless the probability parameter is high.

4. PERFORMANCE ANALYSIS

We have used the ns-2 simulator [19] to conduct extensive experiments to evaluate the performance behavior of probabilistic flooding in FSR protocol. The network considered for the performance analysis of the rebroadcast probability vs. density has been varied from 25 nodes up 100 placed randomly on 600 X 600 m^2, with each node engaging in communication transmitting within 250m radius and having bandwidth of 2 Mbps. The retransmission probabilities have been varied from 0.1 to 1.0% with 0.1% increment per trial. The random waypoint model [15, 16] has been used for simulation. 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. The maximum speeds (max_speed) of 0, 5,10,15,20 m/s and pause times of 0’ s are considered for the purposes of this study. It is worth noting that the simulation parameters used in this study have been widely adopted in existing performance evaluation studies of MANETs [15,16], and are summarized below in Table 1.

Table 1.Summary of the parameters used in the Simulation experiments

Simulation Parameters	Value
Transmitter range	250 m
Bandwidth	2 Mbit
Simulation Time	100 seconds
Pause Time	0, 5, 10 seconds
Topology Size	600 X 600 m2
Number of Nodes	25,50,75,100
Maximum Speed	0, 5, 10, 15, 20 m/sec

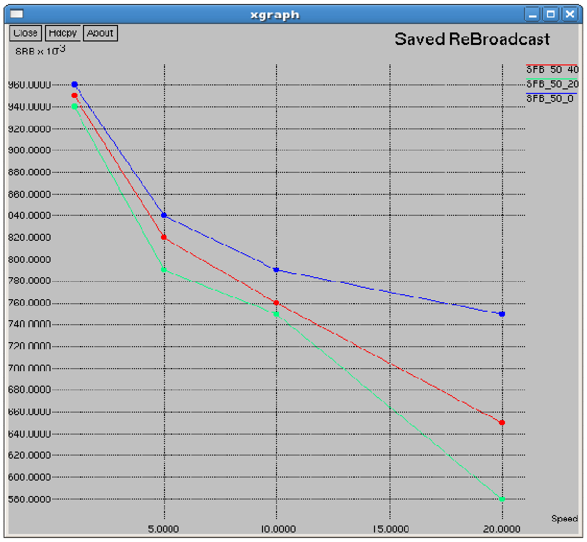

Fig. 2 : Impact of Saved Rebroadcast with 50 Nodes

Fig. 3 : Impact of Saved Rebroadcast with 75 Nodes

4.1. Effect of Speed and Node Pause-Time

The results for saved rebroadcasts achieved by probabilistic flooding are depicted in Figure 3 for continuous (i.e., 0 s pause time) and non-continuous mobility. For each pause time, the maximum node speed has been varied from 1, 5, 10, to 20 m/s. As the results show, the node speed has critical impact on the observed saved rebroadcast value since for each probability value, as the mean node speed increases the saved rebroadcast increases.

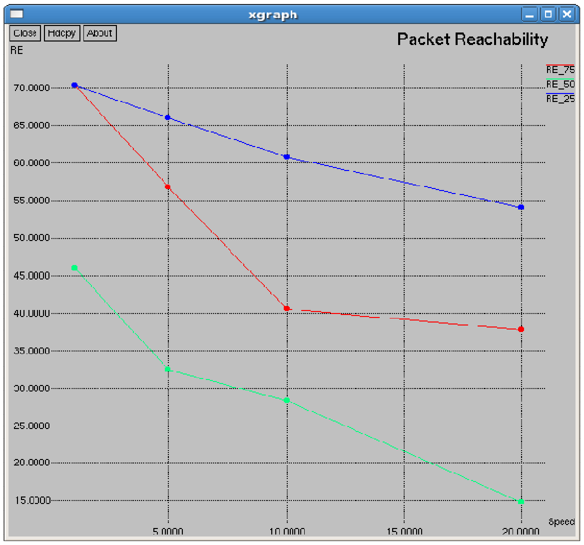

Fig. 4 : Packet Reach ability with different Node Speed 5,10,15,20 m/sec

Figure 4 shows the rebroadcast probability against Packet reach ability across three different maximum node speeds, and the reach-ability achieved in the case of continuous mobility. Overall, across the different broadcast probabilities, reach ability increases as the mean node speed increases.

The saved rebroadcasts and reach ability have also been examined as a function of the rebroadcast probability across different node pause times. In general, the longer the average pause time is, the less the node movement is within the network. The saved rebroadcast achieved by probabilistic flooding is shown for continuous mobility in Figure 2 and 3.The maximum speed of the nodes has been varied from 1, 5, 10 to 20 m/s. For each probability value, as the node pause time increases the amount of saved rebroadcasts increases. Figure 2 and 3 shows the rebroadcast probability against reach ability across three different maximum node speed values. The Packet reach ability achieved for continuous mobility (0 and 20's pause time) is shown in Figure 4. Reach ability exhibits improvement as the mean node pause time increases across the different probability values.

5. SIMULATION RESULTS

As it can be observed from the figures, the saved rebroadcast increases with higher nodes speeds and traffic load. The amount of saving (SRB) increases as the traffic load of the nodes increases, the number of nodes covering a particular area also increases. As the probability of the transmission is fixed for every node this implies that these are more candidates for transmission in each ‘‘coverage’’ area. Hence, there is greater chance that a transmission will occur, thus (SRB) increases at the level each probability. In addition to that, (SRB) decreases as p increases in addition as node speed increases the connectivity increases then the probability of partitioning decreases thus (SRB) increases at certain period of time (Figure 10). From the result figure 5 shows the initial deployment of nodes placed randomly and in figure 6 the flooding starts marked with red circles. Figure 7 and 8 explains as red color nodes shows that flooding message rebroadcast to its neighbors. In figure 9, entire nodes in the network rebroadcasts. Finally in figure 10, after certain period of time some node does not rebroadcast which is shown in blue color as they are saved. The below figures 5 to 10 are the simulation output results from Ns 2 Simulator.

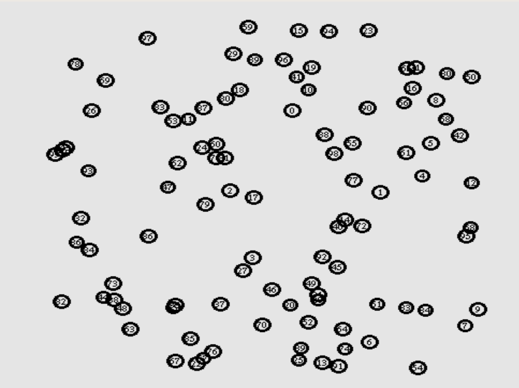

Fig. 5: Initial Deployment of nodes with Random placement

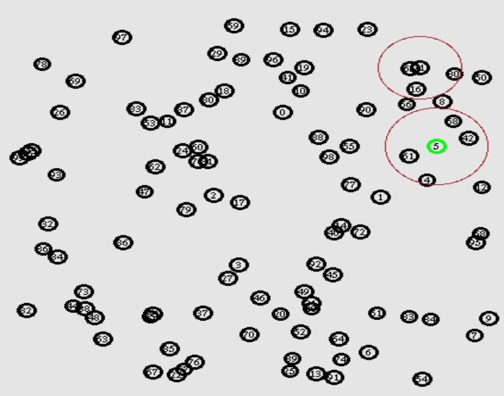

Fig. 6 : Red circle shows flooding starts

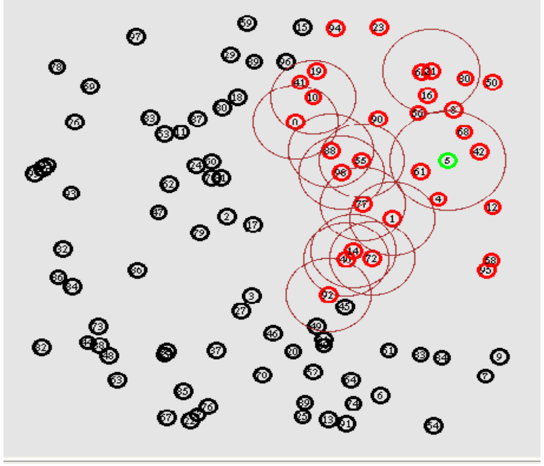

Fig. 7 : Red color nodes shows that flooding message rebroadcast to its neighbors

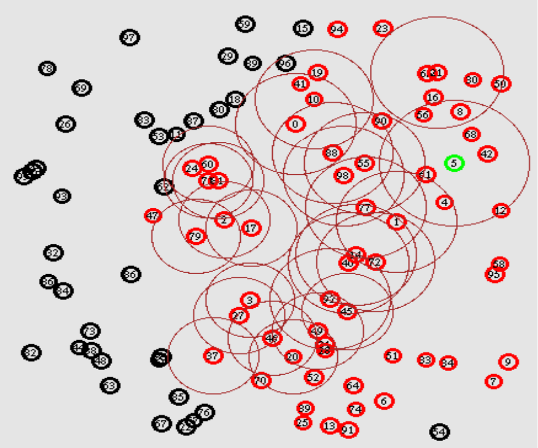

Fig. 8: Rebroadcast flooding message

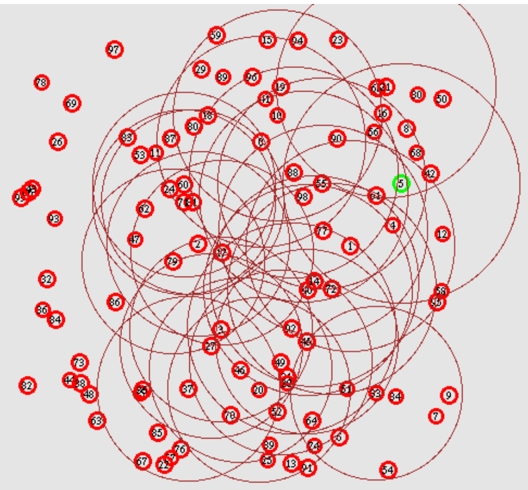

Fig. 9: Entire network shows rebroadcasting

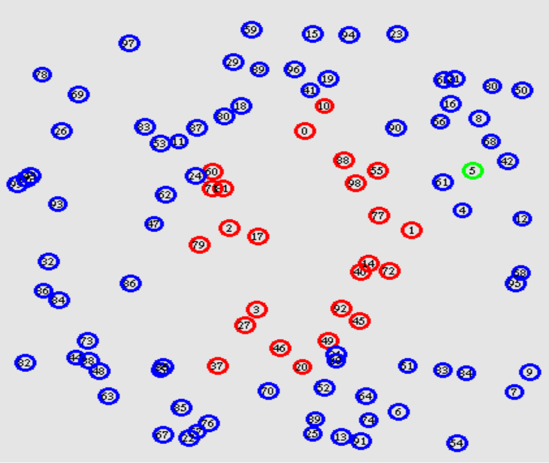

Fig. 10: After certain period of time some node does not rebroadcast shown in blue color

6. CONCLUSIONS AND FUTURE WORK

This paper has analyzed the effects of node speed and pause - time on the performance of the probabilistic approach to flooding (or broadcasting) in MANETs. Results from extensive ns-2 simulations have revealed that mobility and pause times have a substantial effect on the reach ability and saved rebroadcast metrics. The results have shown that for different rebroadcast probabilities, as the node speed increases, reach ability and saved rebroadcast decreases. Moreover, as the pause-time increases saved rebroadcast increases. So, during Simulation at certain period of time some node does not rebroadcast as messages are saved. In Future work, similar performance trends can be observed when the other important system parameters, notably with node density and traffic load, which may have a great impact on the degree of reach ability and the number of saved rebroadcasts achieved by the probabilistic broadcasting scheme.

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