Performance Evaluation of Dynamic Probabilistic Flooding Using Local Density Information in MANETs

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Abstract. Flooding is an obligatory message dissemination technique for network-wide broadcast within mobile ad hoc networks (MANETs). The conventional blind flooding algorithm causes broadcast storm problem, a high number of unnecessary packet rebroadcasts – thus resulting in high contention and packet collisions. This leads to significant network performance degradation. Because of the highly dynamic and mobile characteristics of MANETs, an appropriate probabilistic broadcast protocol can attain higher throughput, significant reduction in the number of rebroadcast messages without sacrificing the reachability. This paper proposes a new probabilistic approach that dynamically fine-tunes the rebroadcasting probability for routing request packets (RREQs). We assess the performance of the proposed approach by evaluating it against the ad-hoc on demand distance vector (AODV) routing protocol (which follows blind flooding approach), fixed probabilistic approach and the existing dynamic probabilistic approaches. The simulation results reveal that the proposed approach demonstrates better performance than the existing approaches.

1 Introduction

Mobile ad hoc networks (MANETs) are self-organizing mobile wireless networks that do not rely on a preexisting infrastructure to communicate. Network-wide dissemination is used widely in MANETs [1] for the process of route invention, address resolution, and other network layer tasks. For example, on demand routing protocols such as ad-hoc on demand distance vector (AODV) [8] and dynamic source routing (DSR) [12] use the broadcast information in route request packets to construct routing tables at every mobile node [3]. The lively nature of MANETs, however, requires the routing protocols to refresh the routing tables regularly, which could generate a large number of broadcast packets at various nodes. Since not every node in a MANET can communicate directly with the nodes outside its communication range, a broadcast packet may have to be rebroadcast several times at relaying nodes in order to guarantee that the packet can reach all nodes. Consequently, an inefficient broadcast approach may generate many redundant rebroadcast packets [5].

There are many proposed approaches for dissemination in MANETs. The simplest one is the flooding. In this technique, each mobile host rebroadcasts the broadcast

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packets when received for the first time. Packets that have already been received are just discarded. Though flooding is simple, it consumes much network resources as it introduces a large number of duplicate messages. It leads to serious redundancy, contention and collision in mobile wireless networks, which is referred to broadcast storm problem [2].

In this paper, we propose a dynamic probabilistic broadcast approach that can efficiently reduce broadcast redundancy in mobile wireless networks. The proposed algorithm dynamically calculates the host rebroadcast probability according to number of neighbor nodes information. The rebroadcast probability would be low when the number of neighbor nodes are high which means host is in dense area and the probability would be high when the number of neighbor nodes are low which means host is in sparse area.

We evaluate our proposed approach against the simple flooding approach and the fixed probabilistic approach, dynamic approach [3] and adjusted probabilistic [4] by implementing them in a modified version of the AODV protocol. The simulation results show that broadcast redundancy can be significantly reduced through the proposed approach.

The rest of this paper is structured as follows. Section 2 includes the background and related work of dissemination in MANETs. Section 3 presents the proposed dynamic probabilistic approach, highlighting its distinctive features from the other similar techniques. The parameters used in the experiments and the performance results and analysis to evaluate the effectiveness and limitation of the proposed technique are presented in Section 4. Section 5 concludes the paper and outlines the future work.

2 Related Work

This section analyses the related work which directly or indirectly aims at reducing the number of broadcast packets generated by the flooding algorithm. The high number of redundant broadcast packets due to flooding in MANETs has been referred to as the Broadcast Storm Problem [2].

There are five proposed flooding schemes [6] in MANETs called probabilistic, counter-based, distance-based, location-based [2] and cluster-based [2, 6]. In the probabilistic scheme, when receiving a broadcast message for the first time, a host rebroadcasts the message with a fixed probability P. The counter-based scheme inhibits the rebroadcast if the message has already been received for more than C times. In the distance-based scheme a node rebroadcasts the message only if the distance between the sender and the receiver is larger than a threshold D.

The location-based scheme rebroadcasts the message if the additional coverage due to the new emission is larger than a bound A. Finally, the cluster-based scheme uses a cluster selection algorithm to create the clusters, and then the rebroadcast is done by head clusters and gateways. The authors conclude by the efficiency of the location-based scheme [2], but these end additional area coverage protocols need a positioning system.

Cartigny and Simplot [1] have described a probabilistic scheme where the probability P of a node for retransmitting a message is computed from the local