ABSTRACT

Mobile Ad-hoc Networks (MANETs) have lately come to be widely used in everyday applications. Their usability and capability have attracted the interest of both commercial organizations and research communities. Recently, the Vehicular Ad-hoc Network (VANET) is a promising application of MANETs. It has been designed to offer a high level of safety for the drivers in order to minimize a number of roads accidents. Broadcast communication in MANETs and VANETs, is essential for a wide range of important services such as propagating safety messages and Route REQuest (RREQ) packets. Routing is one of the most challenging issues in MANETs and VANETs, which requires high efficient broadcast schemes.

The primitive and widely deployed method of implementing the broadcast is simple 'flooding'. In this approach, each node 'floods' the network, with the message that it has received, in order to guarantee that other nodes in the network have been successfully reached. Although flooding is simple and reliable, it consumes a great deal of network resources, since it swamps the network with many redundant packets, leading to collisions contention and huge competition**,** while accessing the same shared wireless medium. This phenomenon is well-known in MANETs, and is called the *Broadcast Storm Problem*.

The first contribution of this thesis is to design and develop an efficient distributed route discovery scheme that is implemented based on the probabilistic concept, in order to suppress the broadcast storm problem. The proposed scheme is called a Probabilistic Disturbed Route Discovery scheme (PDRD), and it prioritizes the routing operation at each node with respect to different network parameters such as the number of duplicated packets, and local and global network density. The performance of the proposed scheme PDRD has been examined in MANETs, in terms of a number of important metrics such as RREQ rebroadcast number and RREQ collision number. Experimental results confirm the superiority of the proposed scheme over its counterparts, including the Hybrid Probabilistic-Based Counter (HPC) scheme and the Simple Flooding (SF) scheme.

The second contribution of this thesis is to tackle the frequent link breakages problem in MANETs. High mobility nodes often have frequent link breakages; this potentially leads to re-discovery of the same routes. Although different probabilistic solutions have been suggested to optimize the routing in MANETs, to the best of our knowledge they have not focused on the problem of frequent link breakages and link stability.

Unlike other existing probabilistic solutions, this thesis proposes a new Velocity Aware-Probabilistic (VAP) route discovery scheme, which can exclude unstable nodes from constructing routes between source and destination. The main idea behind the proposed schemes is to use velocity vector information to determine the stable nodes and unstable nodes. A proper rebroadcast probability and timer are set dynamically according to the node stability. Simulation results confirm that the new proposed scheme has much better performance in terms of end-to-end delay, RREQ rebroadcast number and link stability.

The routing in VANETs is very critical and challenging in terms of the number of broken links and packet overheads. This is mainly due to the fast vehicles' speed and different vehicles' movement directions. A large number of routing protocols such as Ad-hoc On-demand Distance Vector (AODV) and Dynamic Source Routing (DSR) have been proposed to deal with the routing in MANETs. However, these protocols are not efficient and cannot be applied directly to VANETs context due to its different characteristics. Finally toward this end, this thesis proposes new probabilistic and timer probabilistic routing schemes in order to improve the routing in VANETs. The main aim of the proposed schemes is to set up the most stable routes to avoid any possible link breakage. These schemes also enhance the overall network performance by suppressing the broadcast storm problem, which occurs during the route discovery process. The proposed schemes also make AODV protocol suitable and applicable for VANETs. Simulation results show the benefit of the new routing schemes in terms of a number of metrics such as RREQ rebroadcast number, link stability and end-to-end delay.