Chapter 8
Simulation of a Dynamic-Noise-Dependent Probabilistic Algorithm in MANETs

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ABSTRACT
In the current dynamic probabilistic algorithm, the retransmission probability ($p_t$) has always been formulated as a linear/non-linear function of a single variable, namely, the number of first-hop neighbors ($k$), and therefore denoted as $p_t(k)$. The performance of the probabilistic algorithm has severely suffered in the presence of noise due to the reduction in the probability of reception ($p_c$) of route request packets by receiving nodes. This chapter presents a detailed description of a new dynamic probabilistic algorithm in which $p_t$ is determined as a function of $k$ and $p_c$, and therefore, it is referred to as the Dynamic Noise-Dependent Probabilistic (DNDP) algorithm. The DNDP algorithm is implemented using the Mobile Ad Hoc Network (MANET) Simulator (MANSim), which is used to simulate a number of scenarios to evaluate and compare the performance of the algorithm with pure flooding and fixed and dynamic probabilistic algorithms. The simulation’s results demonstrated that the DNDP algorithm provides an excellent performance in various network conditions, where it almost maintains the same network reach-ability in noiseless and noisy environments, with the noisy environments inflicting an insignificant increase in the number of redundant retransmissions.

INTRODUCTION
A Mobile Ad Hoc Network (MANET) is defined as a collection of low-power wireless mobile nodes forming a temporary network without the aid of any established infrastructure or central-
Dynamic routing protocols consist of two major phases, these are: (1) route discovery in which a route between source and destination nodes is established for the first time, and (2) route maintenance in which the route is maintained; and if it is broken for any reason, then the source node either finds other known route on its routing table or initiates new route discovery procedure (Royer & Toh, 1999, Rajaraman, 2002). It has been recognized that the cost of information exchange during route discovery is higher than the cost of point-to-point data forwarding after the route is established (Rahman, et al., 2004).

Broadcasting is a fundamental communication primitive for route discovery in MANETs. One of the earliest broadcast mechanisms proposed in the literature is pure flooding, which is also called simple or blind flooding (Bani-Yassin, et al., 2006). Although it is simple and reliable, pure flooding is costly where it costs \( n \) transmissions in a network of \( n \) reachable nodes. In addition, pure flooding in wireless networks results in serious redundancy, contention, and collisions in the network; such a scenario has often been referred to as the Broadcast Storm Problem (BSP) (Tseng, et al., 2002).

To eliminate the effects of the BSP during route discovery in MANETs, a variety of flooding optimization techniques have been developed to reduce the number of retransmission. As the number of retransmissions required for broadcasting is decreased, the bandwidth is saved and contention, collision, and node power consumption are reduced, and this will improve the overall network performance. Examples of flooding optimization algorithms: probabilistic broadcast (Al-Bahadili, 2010; Qayyum, et al., 2002), counter-based and distance-based (Tseng, et al., 2002), cluster-based (Bettstetter, 2004), etc.

This chapter concerns with the probabilistic broadcast algorithm. In this algorithm, each intermediate node (any node on the network except the source and the destination) is assigned a certain retransmission probability \( p \). There are two approaches that can be used to set a satisfactory \( p \) for intermediate nodes within the network, namely, static and dynamic approaches. In the former approach, a pre-determined \( p \) is set for each node on the networks, while for the later, each node on the network locally and dynamically calculates its \( p \) according to the number of first-hop neighboring nodes \( k \) and therefore \( p \) is expressed as: \( p = f(k) \), where \( f(k) \) is a linear/ non-linear function of \( k \).

In reality, communication channels in MANETs are unreliable due to many types of impairments, such as: signal attenuation, free space loss, noise, atmospheric absorption, etc. In addition, in MANETs, error in reception may occur due to rapidly changing topologies that are caused by nodes movement. All of these impairments and changing topologies may cause an error in reception and are represented by a generic name, noise (Al-Bahadili & Jaradat, 2007). The effect of noise in MANET can be simulated through introducing a probability factor that is the probability of reception \( p_c \), and then the effect of noise can be determined randomly by generating a random number \( \xi \) \((0 \leq \xi < 1)\). If \( \xi \leq p_c \), then the packets is successfully delivered to the receiving node, otherwise, unsuccessful delivery occurs and the packet is lost.

It has been proved in the literature that the performance of probabilistic route discovery algorithm is severely suffered in presence of noise (Al-Bahadili & Kaabneh, 2010). Due to the fact that presence of noise increases packet-loss rate in the network or in other words it decreases \( p_c \) of a RREQ packet by neighboring nodes and consequently the destination node. In order to enhance