Chapter 15
A Study of Speed Aware Routing for Mobile Ad Hoc Networks

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ABSTRACT
The flexibility of movement for the wireless ad hoc devices, referred to as node mobility, introduces challenges such as dynamic topological changes, increased frequency of route disconnections and high packet loss rate in Mobile Ad hoc Wireless Network (MANET) routing. This research proposes a novel on-demand routing protocol, Speed-Aware Routing Protocol (SARP) to mitigate the effects of high node mobility by reducing the frequency of route disconnections in a MANET. SARP identifies a highly mobile node which forms an unstable link by predicting the link expiration time (LET) for a transmitter and receiver pair. NS2 was used to implement the SARP with ad hoc on-demand vector (AODV) as the underlying routing algorithm. Extensive simulations were then conducted using Random Waypoint Mobility model to analyze the performance of SARP. The results from these simulations demonstrated that SARP reduced the overall control traffic of the underlying protocol AODV significantly in situations of high mobility and dense networks; in addition, it showed only a marginal difference as compared to AODV, in all aspects of quality-of-service (QOS) in situations of low mobility and sparse networks.

INTRODUCTION
Mobile Ad Hoc Networks (MANET) are complex distributed systems comprising wireless mobile devices called MANET nodes that can freely and dynamically self-organize into arbitrary and temporary ad hoc network topologies. In MANETs, nodes internetwork seamlessly in areas with no pre-existing communication infrastructure (e.g., in tactical military networks, disaster recovery environments) providing a new and easily deployed wireless communication medium. Mobile wireless devices otherwise referred to as MANET nodes, within the transmission range connect with one
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another through automatic configuration and set up an ad hoc network. A MANET node may be a PDA, laptop, mobile phone, and other wireless device mounted on high-speed vehicles, mobile robots, machines, and instruments; thus, the network topology is highly dynamic. The MANET nodes have computational power and routing functionality that allow them to function as sender, receiver, or an intermediate relay node or router.

Initially, MANETs were used primarily for tactical network applications to improve battlefield communications or survivability. More recently, however, the introduction of new technologies such as the Bluetooth, IEEE 802.11, and HIPERLAN has laid foundation for commercialization of MANET. MANET deployments have begun taking place outside the military domain (Tonguz et al., 2006; Varshey et al., 2000). These recent innovations have generated a renewed and growing interest in the research and development of MANETs.

Mobility has been a major hindrance to the smooth operation of a MANET protocol (Corson & Macker, 1999). It increases link disruption and, consequently, higher network activities, exerting pressure on protocol performance. Increased network operation forces protocols to generate more control packets; thereby increasing the control overhead. Thus, a robust protocol capable of routing effectively within a highly mobile environment and without compromising its inherent attributes is vital for successful deployment of a MANET. In other words, a protocol must maintain information about the speed of the intermediate nodes and use this information to determine a stable routing path with minimal overhead.

The research presented in this paper sought to optimize MANET routing using a new routing mechanism based on node mobility. A popular and widely-employed MANET routing protocol, ad hoc on-demand vector (AODV) (Oliveira et al., 2010), was modified to drop packets when node mobility does not permit a node to form a link for the necessary amount of time. This new routing protocol is called the Speed-Aware Routing Protocol, referred to as SARP here forth. Network simulator, ns-2.33, was used to implement SARP and design and perform a variety of experiments to ensure that SARP fulfills the need to incorporate speed-awareness in a MANET’s route discovery mechanism. In addition, simple empirical simulations similar to those used in Akunuri et al. (2010), Perkins and Royer (1999), Das et al. (2000), Manvi et al. (2010), and Tongus and Ferrari (2006) including random movement and traffic scenarios were run to perform a comparative study to analyze the performance of SARP against the established AODV.

PROBLEM STATEMENT

Mobility in MANETs

The ad hoc and mobile nature of the node imposes a number of restrictions on a MANET. Some of the restrictions are the limited battery power, restricted bandwidth allocation, limited transmission power and hence, limited communication range. This in turn restricts the nodes’ involvement in the routing activity. A MANET node should, hence, be utilized in an efficient way with a smart routing mechanism.

Amongst various fields of MANET routing, node mobility has so far grabbed comparatively little research emphasis. The two applications that captured majority of the work that involved node mobility were designing realistic mobility models or the usage of node mobility to improve the link connectivity time. In Xiaojiang and Dapeng (2006), Athanasios (2006), and Aziz et al. (2009), different strategies have been implemented to satisfy different degrees of mobility. Also, much research has been focused on designing competitive mobility models for the simulators; as seen in Bai and Helmy (2007), Bai et al. (2003), Hong et al. (2007), and Hassan et al. (2010).
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