A ROBUST TOPOLOGY MANAGEMENT ALGORITHM FOR MOBILE AD-HOC NETWORKS USING STOCHASTIC PROPERTIES OF NODE MOBILITY

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A Mobile Ad-Hoc Network (MANET) is a decentralized network of autonomous mobile nodes able to communicate over wireless links without the help of any fixed infrastructure [1, 2]. MANET is projected to play a vital role in applications like search-and-rescue operations, multi-platform battle deployment, mobile sensors or satellite networks for quick sharing and acquisition of data in inhospitable terrain.

In MANET, the nodes act as individual routers besides being the regular transceivers. The current focus of the researchers is to prescribe a routing algorithm which is adaptive with the network mobility. The existing routing protocols [1,2] for MANET can be categorized into four types namely Flooding, Proactive routing, Reactive routing and Dynamic Cluster based routing. The main concern of all these types of routing protocols is to provide a reasonably stable route between two arbitrary nodes in the mobile network, with a reduction in time complexity and control message overhead. But, none of these existing protocols takes care to maintain constant connectivity between the nodes within the network. In the worst case, a node can even get disconnected from the whole network and hence the concept of topology management came into picture. A self-adaptive topology management algorithm [2] tries to maintain the overall topology of the network and at the same time eliminates the risk of detachment of a node due to its mobility. It is also expected that topology management algorithms will prove to be efficient in applications like rescue operations, battlefields, mobile sensors or mountaineering.

In our work, we have proposed a robust topology management algorithm for MANET. The basic philosophy of the algorithm is to elect a group leader from the nodes and to endow it with the responsibility of managing the network neighborhood topology, thereby allowing the nodes to communicate with each other without any requirement of routers. The leader performs this task by controlling the motion of the nodes so as to restrict those within a predefined zone of stability. The zone of stability is defined in such a fashion that any two nodes within that zone can communicate directly with each other. The group leader uses the stochastic properties of the nodes' random waypoint mobility model [3] to calculate the probabilities of divergence of the nodes from the zone of stability. Next, based on some predefined threshold probability, it controls the motion of the nodes to manage the neighborhood topology, thereby ensuring that the connectivity of one node with other will not change during the movement of the network. Hence, the routing overhead may completely be eliminated. We have simulated our algorithm through a number of synthetically designed network situations using various thresholds and have obtained encouraging results. A comparative study of our algorithm with other topology management algorithms [2, 4] has also been made and the results thus obtained show the effectiveness of the algorithm, both in terms of efficiency and robustness.

Keywords: Mobile Ad-Hoc Network, Topology Management, Self-adaptive, Zone of Stability, Random Waypoint Motion.

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