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Title: Resilience Mechanisms for Survivable Mobile ad-hoc Network

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. In this work we define resilience as the capability of the mobile ad hoc network to offer and retain a tolerable level of service in condition of different kinds of faults as well as challenges to usual network operation. We consider that resilience must be seen as a critical design and operational attribute of potential wireless networks like MANETs/VANETs/WSN. The vulnerabilities of the recent wireless networks and the necessity for better resilience mechanisms are generally recognised. Survivability is the ability of a MANET to fulfill its task, in a time bound way, in the occurrence of threats like attacks as well as large-scale natural calamity. So the goal of the proposed work is finding out the way for resilience mechanisms for survivable mobile ad hoc network. One way of accomplishing this task is to explore broadcasting techniques for mobile ad hoc networks. Broadcast communication in MANETs 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, which requires highly 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 research is to design and develop an efficient route discovery scheme that is implemented based on the probabilistic concept, in order to suppress the broadcast storm problem. The proposed scheme is called Energy aware probabilistic broadcasting (EAPB) which ameliorates the network performance by decreasing the RREQ overhead in route discovery phase. In comparing the simulation results of AODV which employs blind flooding and fixed probability against the combination of AODV and the proposed probabilistic broadcasting, the later has been found to reduce both overhead as well as the end to end delay. Energy Aware Probabilistic Broadcasting (EAPB) takes into account, the remaining energy of the nodes, while calculating the rebroadcast probability. For the evaluation of EAPB scheme, the AODV routing algorithm has been used. Based on our simulation results, the AODV implemented EAPB helps to improve the end-to-end delay and reduces the overall routing

overhead when compared to the conventional AODV which uses blind flooding and fixed probability.

The second contribution of this work is to tackle the overhead problem in MANETs. We have proposed an efficient fuzzy logic based probabilistic broadcasting for AODV protocol in order to reduce overheads. The fuzzy based logic criteria make decisions which are based on some of the important parameters affecting broadcasting like number of neighbors, bandwidth available and remaining energy. The simulation result shows that the proposed algorithm is efficient and reliable with respect to the consumed power, throughput, overhead, collision rate and it also maintains low normalized routing load as compared to AODV and other routing protocols proposed in the literature in which simple flooding or fixed probability broadcasting is used.

The third contribution of this work is a novel broadcasting algorithm, namely energy efficient Probabilistic Broadcasting (EEPB) that improves probabilistic broadcast methods to broadcast the RREQ packets and gives better results as compared to other energy efficient probabilistic broadcasting schemes like Energy aware gossip (EAG), Energy constraint gossip (ECG), Energy Based gossip (EBG) and Network lifetime energy efficient broadcast gossip (NEBG). The simulation results illustrate that the implementation of AODV with EEPB further assists to decrease the general routing overhead with less power consumption of nodes.

Finally toward this end, a novel broadcasting algorithm using particle swarm optimization probabilistic broadcasting (PSOPB) is proposed in order to improve the strategy for each node to decide the retransmission probability. The main aim of the proposed scheme determines the most efficient strategy for each node to decide the retransmission probability according to its neighborhood density, available bandwidth and remaining energy of a node. It uses a tool which combines a network simulator (ns-2) and a particle swarm optimization algorithm. Then, it is applied to the MANET broadcasting problem. The simulation results show that the proposed particle swarm optimization probabilistic broadcasting (PSOPB) scheme is reliable and efficient in comparison with the other artificial intelligence broadcasting schemes like Elitist simulated binary evolutionary algorithm (ESBEA), Multi-objective problems with Pareto front solution (MOP_PF) and efficient fuzzy logic based probabilistic broadcasting (EFPB).