ABSTRACT

In Mobile Ad-hoc Networks (MANETs), reliability and power consumption are the two major factors which affect routing. Improvement in reliability requires reduction in packet losses during data transmission. Packet loss may occur due to network congestion or bad channel quality. But TCP based congestion control technique assumes that any packet loss is due to network congestion. Hence both the transmission rate and link stability should be checked and regulated. Estimating the link stability on the basis of the node speed alone cannot ensure accuracy; also the transmission data rate should be adjusted on the basis of transmission power. Static resource allocation in MANET is inadequate or under-exploited due to the varying nature of traffic. These problems are common for both unicast and multicast routing protocols.

This research work overcomes these issues by providing cross-layer based approaches for unicast and multicast routing protocols in MANET. The cross-layer based solutions for unicast routing involves fuzzy based routing and rate control, power aware rate adjustment and fair resource allocation. The cross-layer based solution for multicast routing involves a fuzzy based routing decision model.

A fuzzy-based cross-layer routing and rate control protocol for MANET is proposed for path selection and rate adjustment. It consists of two Fuzzy Logic System (FLS) models: FLS1 and FLS2. FLS1 selects the best path, whereas FLS2 helps for rate adjustment. In FLS1, the source node obtains the input parameters such as path stability and bandwidth through route discovery mechanism. These inputs are fuzzified to obtain the optimal path for data transmission. In FLS2, the destination node gets end-to end

delay and packet loss ratio values as inputs. These inputs are fuzzified to estimate the state of transmission rate. The current transmission rate of the path is adjusted through comparison of the initial transmission path with the output of FLS2. This does away congestion in the path.

Then process for selecting the optimal path in FLS1 is extended by considering the path's residual energy of the node along with path stability and bandwidth. This residual energy is estimated at both situations when the node receives and transmits the data packets. Additionally an efficient power and rate control scheme is proposed in that each node updates a table. This table includes energy efficiency in all combinations of transmission power and rate. The current transmission rate of the source is adjusted by comparing the output of FLS2 with initial transmission rate of the path and transmission power and rate table.

A fair resource allocation technique using CFRA protocol is proposed for the selected routes such that the resource utilization is fairly distributed. Using TDMA-MAC protocol, the path bandwidth is estimated and the available time slots are classified. Every node records available timeslots between the nodes and resource reservation information in Resource Allocation Table (RAT). When the nodes receive a resource allocation information message from a neighbour node, it updates its own RAT. The node checks the RAT when it receives R-R message and decides the requested data slots are available or not. When the requested slots are available, the node transmits R-A message otherwise it does not transmit anything.The source node waits for the R-A message before the R-A timer expires.If the source node receives the R-A message, the source node transmits a Resource Confirm (R-C) message including the information of the original R-R message.If the source node does not receive the R-A message before the R-A timer expires, the source node tries reservation again in the next TDMA frame. Finally the node which listens to the R-A and/or R-C messages updates their own RATs.

Finally a cross-layer based multicast routing protocol using fuzzy logic is proposed. In this approach a multicast tree is constructed using Multicast Ad hoc On-demand Distance Vector (MAODV) routing protocol. When the source wants to transmit the data to a destination, it performs the fuzzy based optimal route selection process by considering the parameters such as path stability and bandwidth. The path stability is estimated based on available battery power, distance and link quality.

By simulation results, it is shown that the proposed approaches achieve minimum end-to-end delay, energy consumption, and packet loss ratio with improved bandwidth utilization and packet delivery ratio.