ABSTRACT

Multicast communications are essential for group-oriented applications such as video conferencing, interactive group games, video on demand and e-learning. Most of the real-time multimedia applications running on Mobile Ad hoc Networks (MANETs) have stringent Quality of Service (QoS) requirements for routing packets. It requires a minimum available bandwidth as well as a bound on its end-to-end delay, jitter and packet loss rate on a selected route that must be satisfied. The process of route selection considering multiple constraints is known as the multi-constrained QoS routing problem. However, the problem of finding a feasible path subject to multiple constraints is NP-complete.

In the past, many researchers have proposed novel protocols to deal with multi-constrained QoS multicast routing. However, in all these protocols QoS requirements are limited to only bandwidth and delay. They do not concentrate on other QoS parameters such as jitter, packet loss rate, route stability and battery power of a mobile node required by real-time flows. Hence, it is necessary to find an optimal multicast tree that will meet the multiple QoS requirements of real-time multimedia applications with increased life time and reduced resource consumption.

In this research work, new protocols have been developed in order to obtain a low cost multicast tree by satisfying multiple QoS constraints. The first protocol is a flooding-limited, Multi-constrained QoS Multicast Ad hoc On-demand Distance Vector namely MC-MAODV has been developed to
reduce the flooding of route request packets. The flooding consumes considerable amount of link bandwidth and battery power of mobile nodes and degrades the performance of routing. MC-MAODV employs the admission control strategy at each node. The links those satisfy all the QoS constraints of an application are allowed to make an entry in the routing table. If any one of the constraint is violated, the route request packet will be rejected. Thus, MC-MAODV reduces the search space and eliminates the probability of selecting undesirable nodes and links.

Mobility of nodes adds another dimension to the multi-constrained QoS routing. In MANETs, the reliability of a path depends on the stability or availability of each link of a routing path. Hence the second protocol is aimed to increase the lifetime of a routing path. To achieve this, a mobility prediction mechanism is integrated with MC-MAODV protocol and hence the Mobility Prediction aided Multi-constrained QoS aware Multicast Routing Protocol (MPQMRP) is obtained, which finds a stable path with less control over head and high packet delivery ratio.

A new hybrid routing protocol namely Agent assisted Multi-constrained QoS Multicast Routing Protocol (Agent-MCQMRP) has been developed using agent technology to reduce the route set up latency and conserve the battery power in multi-constrained QoS multicast routing. Most of the multicast routing protocols establish routes on-demand, where a considerable amount of time is spent in finding the routes from source to all the group members. This introduces additional delay to the overall end-to-end delay. The newly developed Agent-MCQMRP employs a set of static and mobile agents for topology discovery with QoS routing metrics and generate a
routing table with that metrics. This routing table is used for proactive routing operations and thus reduces route set up latency, network traffic and conserves energy of mobile nodes.

Effective resource utilization is another important design criterion in QoS routing. Hence, an Agent assisted Fuzzy Cost based Multi-constrained QoS Routing (Agent-FCMQR) protocol has been developed to focus on effective utilization of network resources as well as sufficient support for constrained path computation. In this protocol, a fuzzy logic system based routing decision is adopted for selecting a route with minimum cost and maximum stability by considering remaining battery power and buffer length metrics of a mobile node.

The task of QoS routing is to optimize the network resource utilization while satisfying application requirements. Hence, a multi-constrained QoS multicast routing optimization based on genetic algorithm has been developed to find an optimal multicast tree which minimizes the weighted combination of QoS constraints.

The above protocols support multiple classes of traffic, each with varying QoS requirements. The newly developed protocols are evaluated using extensive simulations with different network scenarios. The simulation results obtained from this research work show that the developed protocols reduce the routing cost considerably by satisfying multiple QoS constraints. Limitations of the developed protocols have been identified and presented for further exploration.