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Genetic Algorithm Based Power Aware Multicast Routing Strategies in Wireless Ad-hoc Network

Meenu Vijarania[1]
[1] *Computer Science Department, Amity School of Engineering and Technology, Amity University, Haryana, India*

ABSTRACT

The mobile ad hoc network is self organized and infrastructure less wireless network where the nodes are randomly distributed and having dynamic topology. In a similar way the normal world is huge, dynamic, extraordinarily different and extremely complex. In MANET, mobile node battery energy is limited and represents one of the important constraints for designing multicast routing protocols. In regards to the battery lifetime limitation in supporting multicast routing, some studies have given a Genetic algorithm solution for saving power. Limited link, path constraints, and mobility of network hosts make the multicast routing protocol design particularly challenging in wireless ad hoc networks. In spite of the intrinsic difficulties of getting by in such a world, biological organisms evolve self repair, explore and self organize. Genetic algorithms have been proven to be an efficient technique for solving the optimization problem, in which well-designed chromosomes and appropriate operators are key factors that determine the performance of the GA. In this paper we investigate different multicast routing protocols, and provide the study of problems identified in these routing as our literature collection.

Keywords: Genetic Algorithm, MANET, QoS, Multicast, Routing

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I. INTRODUCTION

Mobile ad hoc networks (MANETs) are autonomous mobile host systems connected by wireless links, forming a communication network modeled as an arbitrary communication graph without any infrastructure. In MANET the network topology changes dynamically and unpredictably as nodes move freely. In multicasting technique message can be sent to multiple destinations in a group in the network. Multicasting scheme is useful for applications like internet games, video conferencing and online web based learning. As bandwidth is limited in MANET, therefore QoS (Quality of service) can be improved by reduced control and transmission overhead. In order to enhance efficiency of Wireless link, a data packet can be used by all recipients of the multicast group which are in direct sender transmission range. There are various challenges in multicasting system design such as dynamic movement of node in wireless network lead to link failure, reconfiguration and transient loop due to random movement increases the overhead. To resolve this problem in multicasting various protocols are developed in the literature and classification of these protocols is shown in figure1.

QoS aims at finding the efficient and optimal path based on multi constrained QoS viz. bandwith, delay, packet delivery ratio, link connectivity. Therefore it is complex task to take into account multiple constraints in wireless network due to dynamic topology changes. Multicast scheme reduces the delay, processing time at router and channel bandwidth and provide robust communication between source to destination.

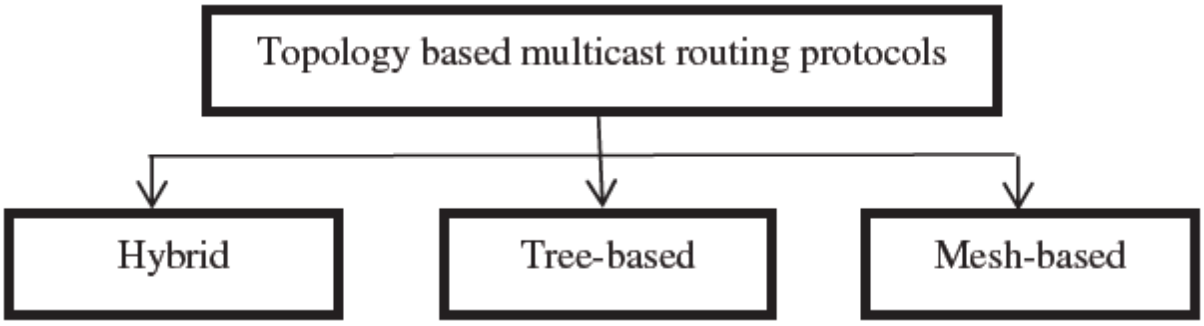

Figure 1: Taxonomy of Multicast routing protocols

II. RELATED WORKS

In [1] proposed a network model and multicast tree selection algorithm that optimizes multiple QoS using genetic algorithm. The QMRGA optimizes the QoS parameters like delay and bandwidth and converge to the optimal solution.

In [3] author proposed new multiple qoS constrained multicast routing optimizationfor ad-hoc network using genetic algorithm. The proposed MQMGA can optimize the selection of the long-life path, maximum link utilization, the average delay, the maximum end-to-end delay and the cost of the multicast tree. The results show that the proposed scheme is an efficient and accurate method for estimating and evaluating the route stability in dynamic mobile networks.

In [4] a novel penalty adjustment method is proposed based on the rough set theory is proposed to deal with path delay constraints for multicast routing problems in MANETs. A constrained optimization problem is formulated , where the objective function is to minimize the total cost of the multicast tree subject to QoS constraints

In [5] author present a new intelligent routing algorithm QOS using swarm intelligence strategy of bee colony. Swarm intelligence is a relatively novel field. It addresses the study of the collective behaviors of systems made by many components that coordinate using decentralized controls and self-organization.

In [6] author proposed a PSO-ODMRP model to support the multicast routing optimization algorithm in mobile ad-hoc networks. The proposed approach and parameters provide an accurate and efficient method in realistic scenarios. However, if there is high mobility speed and high mobile density, the protocol does not find a good optimal solution.

In [7] a Novel Fast Multi-Objective Evolutionary Algorithm for QoS Multicasting Routing in Manet proposed by authors is also known as QMOEA simplifies QoS multicast routing based on Core Based Tree Model (CBT). QMOEA absorbs the “greedy” and “family competition” approaches to speed up the convergence of algorithm and maintain the diversity of population. QMOEA has less running time and is able to achieve faster convergence. This algorithm optimizes four quality of service parameters bandwidth, delay, jitter and packet loss. The main objective of algorithm is that each path should be able to support these QoS metrics.

A Multi-objective genetic algorithm based adaptive QoS routing in MANETs that the authors have proposed in [8]. The proposed algorithm uses MOGA to optimize multiple qualities of service parameters. MOGA can produce a set of optimal values where multiple individuals can search for multiple solutions in parallel manner. The algorithm is able to optimize four parameters bandwidth, hop count, delay and traffic from adjacent nodes. This GA based QoS routing is source based adaptive routing to support mobility of nodes and packets have less delay when the load on

the network is high and when there is mobility of nodes change the topology. The GA works by combining the existing routes in order to generate new routes and select the optimal routes which are able to achieve the quality of service.

Multicasting Routing with Delay and Delay Variation Constraints Using Genetic Algorithm proposed in [9] is a genetic algorithm for delay and delay variation multicast routing (GADVM).This algorithm consider two constraints, first, end to end delay and second, delay variations from one source to each destination. Delay is critical and sensitive factor in multimedia applications. For multicast applications in a network, the proposed algorithm is able to find minimum Steiner tree, T, that satisfies the constraints, Path delay and Delay-variation The proposed algorithm has well performs in terms of failure rate and average cost per path metrics. GADVM has lower failure costs and its cost is also comparable better.

Table1: Comparative analysis of optimization techniques used in the literature

Approach	Technique Used	Advantages	Limitation
Genetic based optimization for multicast routing algorithm for MANET	Genetic Algorithm	Shortest path optimization, load balancing	Does not consider bandwidth constraints.
A Rough Penalty Genetic Algorithm for Multicast Routing in Mobile Ad Hoc Networks	Genetic Algorithm	Path delay in multicast tree is reduced	scalability RPGA in finding multicast routes for dynamic MANETs with large-scale is not considered
Multiple constraints QoS multicast routing optimization algorithm in MANET based on GA	Genetic Algorithm	optimize the maximum link utilization, the cost of the multicast tree, the selection of the long-life path, the average delay and the maximum end-to-end delay	conservative tool to solve multicast routing problems with diverse QoS constraints
BCO-based optimized heuristic strategies for QoS routing	Artificial Bee Colony Algorithm	Multi objective function. Fast convergence	QOS parameters obtained are better in GA compared to ABC
An intelligent mesh based multicast routing algorithm for MANETs using particle swarm optimization.	Particle swarm optimization	Optimization of mesh based routing, Faster convergence.	In high mobility speed and high mobile density, the protocol does not find a good optimal solution
A Novel Fast Multi-Objective Evolutionary Algorithm for QOS Multicasting Routing in Manet (QMOEA)	Based on MOGA model	bandwidth, delay, jitter and packet loss	Time, bandwidth and frequency constraints as metric.
A Multi-objective Genetic Algorithm based Adaptive QoS Routing in Manet	Genetic Algorithm	Bandwidth, Hop Count, Delay and Traffic.	Hop count, bandwidth and Delay constraints are taken into account.
Multicasting Routing with Delay and Delay Variation Constraints Using Genetic Algorithm	Genetic Algorithm	Delay and Delay jitter	Delay and Delay variation is taken as metrics.

III. CONCLUSION

Multicasting is a challenging task in MANETs because of high node mobility and frequent topology change. Multicasting is one of the alternatives of multiple unicast transmissions when same data has to be transmitted for a group of nodes. This paper discusses how the Genetic Algorithm can be applied to implement multicast routing that satisfies Quality of Service constraints. The most commonly QoS parameters that are taken into account as metrics are: Bandwidth, Delay, Delay Variation and Cost. In Some algorithms the authors have considered bandwidth, delay, Packet loss and jitter as QoS metrics and some authors have taken into account energy consumption, cost and traffic load as additional constraints. To select an optimal route in MANET, it is necessary to consider maximum number of Quality of Service Parameters. To the best of our knowledge none of the existing algorithms has considered all the QoS parameters. Most of the authors have used two or three parameters as QoS metrics. So the objective of this paper is to find out the opportunity of research in this area. The future research work can be the development of new Genetic Algorithm based QoS routing techniques for MANET that consider Queuing delay, Bandwidth, Delay, Jitter, Packet loss delay, Buffer delay and Power aware constraint parameters.

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