Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 2, Issue. 5, May 2013, pg.226 – 231

RESEARCH ARTICLE

Implementation of Multicast Routing Using Genetic Algorithm

Priti Gaur[1]

[1]Department of Computer Science & Engineering, Institute of Engineering & Science,
I P S Academy, near Rajendra Nagar, Indore, India

[1] *g.priti4@gmail.com*

Abstract— MANET is a very popular domain of research, due to their ad hoc nature of infrastructure and mobility. This network supports various routing algorithms to implement with it. In this paper we investigate different routing protocols, and provide the study of problems identified in these routing as our literature collection. In addition of that here we propose a new kind of path discovery strategy that promises to deal with dynamically changing network with adoptable QoS parameters. Here we discuss our proposed solution to achieve the desired goal. Our proposed technique uses traditional genetic algorithm and similarity functions that help to improve the performance of the proposed routing algorithm.

Key Terms: - MANET; routing; multicast; multi-hop; Qos

I. INTRODUCTION

MANET is a self-organizing, infrastructure less network, where each participating device is able to send and receive data with independent mobility model. A MANET is a type of ad hoc network that can change locations and configure itself. Because MANETS are mobile, they use wireless connections to connect to various networks. This can be a standard Wi-Fi connection, or another medium, such as a cellular or satellite transmission. Some MANETs are restricted to a local area of wireless devices (such as a group of laptop computers), while others may be connected to the Internet. [2]

MANETs can be defined by several characteristics and properties:

- Dynamic Topologies
- Bandwidth-Constrained, Variable Capacity Links
- Energy-Constrained Operation
- Limited Physical Security

Routing protocols for MANETs must discover paths and maintain connectivity when links in these paths break due to effects such as node movement, battery drainage, radio propagation, and wireless interference.

Multicast is an important network service, which is the delivery of information from a source to multiple destinations simultaneously using the most efficient strategy to deliver the messages over each link of the network only once, creating copies only when the links to the destinations split. An efficient multicast routing algorithm should construct a multicast routing tree, by which the data can be transmitted from the source to all the destinations with a minimum multicast tree cost. The tree cost is used to evaluate the utilization of network resources, which is an important metric especially in wireless mobile networks where limited radio resources are available. [1]

Thus in this paper investigate the multi hop and multi cast routing, for managing and recovering the dynamically optimized the QoS in different network conditions. For that purpose we investigate first different routing techniques and their brief description in the next section.

II. Routing

Multicast: When a number of sender and receiver involved in communication is one-to- many or many-to-many or many-to-one, multicast is used as the means of data communication. The sender(s) and receivers are assumed to be part of a group. The features of a multicast group are described below: [3]

- A host can be a member of any number of multicast groups.
- The membership to a multicast group is dynamic, the sender and receivers can join or leave the group at any time. For scalability, the join and leave operation has to be simple without any side effects.
- To be a sender of a group, it is not necessary that the host is a member of the group.
- Each group is identified by a Class D.
- Data communication is done using User Datagram Protocol (UDP).

With the advent of multicasting, many applications have emerged that can derive maximum benefit from multicasting of data. Some sample applications are video conference, real-time multimedia applications and Distributed Interactive Simulation (DIS). The multicast applications can be divided into the following categories:

- Single-point to multi-point
- Multi-point to multi-point
- Multi-point to single-point

Multicast provides efficient communication and transmission, optimizes performance and enables truly distributed applications. Copies of message are made only when paths divergeat a router, that is, when the message is to be transferred to another route in the path to the receiver or when a receiver is attached to the router. The optimal multicast path is computed as a tree or a group of trees. The quality of the tree is determined by low delay, low cost and light traffic concentration. [3]

Multi-hop: Multi-hop wireless networks typically use routing techniques similar to those in wired networks. These traditional routing protocols choose the best sequence of nodes between the source and destination, and forward each packet through that sequence. In contrast, cooperative diversity schemes proposed by the information theory community suggest that traditional routing may not be the best approach. Cooperative diversity takes advantage of broadcast transmission to send information through multiple relays concurrently. The destination can then choose the best of many relayed signals, or combine information from multiple signals. These schemes require radios capable of simultaneous, synchronized repeating of the signal, or additional radio channels for each relay [4].

But we are working on dynamically changing network problem and optimum route discovery, thus in our problem domain we can involve both kinds of routing. In the next section of our paper we provide the similar works and efforts that previously made for route discovery and optimum data delivery algorithms.

III. Background

The problem of dynamic multicast routing in mobile ad hoc networks is investigated. [1] Lots of interesting works have been done on multicast routing. However, most of them consider the static network scenarios only and the multicast tree cannot adapt to the topological changes. In a mobile adhoc network, the network topology keeps changing due to its inherent characteristics. Therefore, an effective multicast algorithm should adapt the best multicast tree to the changes accordingly. In this paper, author proposes to use two types of hyper-mutation genetic algorithms to solve the dynamic multicast routing problem in MANETs. The two GAs are named as highlow hyper-mutation GA and gradual hyper-mutation GA, respectively. The experimental results show that hyper-mutation GA can quickly adapt to the environmental changes and produce high quality solutions following each change.

In the same way "Cross-layer Routing and Dynamic Spectrum Allocation in Cognitive Radio Ad Hoc Networks" works on Throughput maximization. The main challenge in cognitive radio ad hoc networks is where the availability of local spectrum resources may change from time to time and hop-by-hop. For this reason, a cross-layer opportunistic spectrum access and dynamic routing algorithm for cognitive radio networks is proposed, called ROuting and Spectrum Allocation algorithm. Through local control actions, ROSA aims at maximizing the network throughput by performing joint routing, dynamic spectrum allocation, scheduling, and transmit power control. The algorithm dynamically allocates spectrum resources to maximize the capacity of links without generating harmful interference to other users while guaranteeing bounded bit error rate (BER) for the receiver. the algorithm aims at maximizing the weighted sum of differential backlogs to stabilize the system by giving priority to higher-capacity links with high differential backlog. The proposed algorithm is distributed, computationally efficient, and with bounded BER guarantees. [5]

The propagation of mesh or ad hoc network protocols has led to a push for protocol standardisation. While there are a number of both open-source and proprietary mesh routing protocols being developed, there is only a small amount of literature available that shows relative strengths and weaknesses of different protocols. This paper investigates the performance of a number of available routing protocols using a real-world test bed.

Investigations focus on the multi-hopping performance and the ability of each routing protocol to recover from link failures. Results show that B.A.T.M.A.N. and BABEL outperform OLSR both in terms of multi-hopping performance and in route re-discovery latency. [6]

The static shortest path problem has been well addressed using intelligent optimization techniques, [7]. However, with the advancement in wireless communications, more and more mobile wireless networks appear, e.g., mobile networks [mobile ad hoc networks (MANETs)], wireless sensor networks, etc. One of the most important characteristics in mobile wireless networks is the topology dynamics. Therefore, the SP routing problem in MANETs turns out to be a dynamic optimization problem. This paper uses GAs with immigrants and memory schemes to solve the dynamic SP routing problem in MANETs. Here consider MANETs as target systems because they represent new-generation wireless networks. The experimental results show that these immigrants and memory-based GAs can quickly adapt to environmental changes and produce high-quality solutions after each change. [7]

The network needs to cope with battery constraints, while providing QoS (end-to-end delay and reliability) guarantees. Designing such QoS routing protocols that optimize multiple objectives is computationally intractable. Higher power relay nodes can be used as cluster heads in a two tiered WSN and these relay nodes may form a network among themselves to route data towards the sink. In this model [8] the QoS guarantee is determined mainly by these relay nodes. this paper provide a solution based on NSGA-II for energy efficient QoS routing in cluster based WSNs. Simulation results demonstrate that the proposed protocol outperforms network performance by optimizing multiple QoS parameters and energy consumption. [8]

In this section we provide the previously made efforts and proposed work to improve the QoS of wireless network using AI techniques. In the next section we discuss basic algorithm and the fitness calculation and optimization technique to reduce the evaluation cycle. By which we find the optimum path in dynamically changing network faces.

IV. Problem Area and Solution Domain

Our basic problem of the MANET is their ad hoc nature where not any fixed points are available for dynamically moving nodes (devices). That is observed using a simple example, in the below diagram a wireless network is given and there are two nodes are available with label A and B. suppose node A want to send some data to B, then path is discovered first then data flooding is initiated.

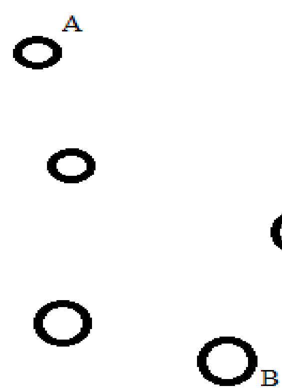

Fig 1 shows the nodes at a time instance

But due to mobility if node B changes their position from one place to other then problem arises for communication point of view. In addition of that to manage the efficiency and power consumption is another problem which leads to store less data on nearest nodes.

This dynamically changes in network leads to improve the routing strategy and path discovery. For that purpose here we propose a hybrid Genetic Algorithm for improving the path discovery.

Genetic Algorithm

Genetic algorithm is one of the popular approaches for making search for large amount of data. The bio informatics knowledge is used to find the fittest answers in number of repetitive or iterative calculations.So first we discuss the primary functioning of the genetic algorithm.

The evolutionary algorithms use the three main principles of the natural evolution: reproduction, natural selection and diversity of the species, maintained by the differences of each generation with the previous. [9]

Genetic Algorithms works with a set of individuals, representing possible solutions of the task. The selection principle is applied by using a criterion, giving an evaluation for the individual with respect to the desired solution. The best-suited individuals create the next generation.

Generate initial population –the algorithms in first generation randomly generated, by selecting the genes of the chromosomes among the allowed alphabet for the gene. Because of the easier computational procedure it is accepted that all populations have the same number (N) of individuals.

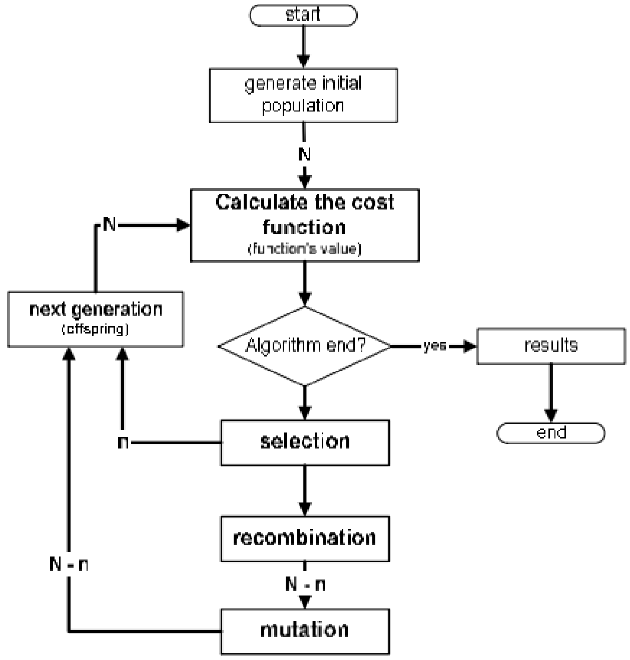

Fig 2 Genetic algorithm

Calculation of the values of the function that we want to minimize of maximizes.

Check for termination of the algorithm – as in the most optimization algorithms, it is possible to stop the genetic optimization by:Value of the function, Maximal number of iterations and Stall generation

Selection – between all individuals in the current population are chose those, who will continue and by means of crossover and mutation will produce offspring population. At this stage elitism could be used – the best n individuals are directly transferred to the next generation. The elitism guarantees, that the value of the optimization function cannot get worst (once the extreme is reached it would be kept).

Crossover – the individuals chosen by selection recombine with each other and new individuals will be created. The aim is to get offspring individuals, which inherit the best possible combination of the characteristics (genes) of their parents.

Mutation – by means of random change of some of the genes, it is guaranteed that even if none of the individuals contain the necessary gene value for the extreme, it is still possible to reach the extreme.

New generation – the elite individuals chosen from the selection are combined with those who passed the crossover and mutation, and form the next generation.

In this section we discuss the need and the problem that is required to solve in our proposed work, in the next section we include the modification on the genetic algorithm and provide the way and scenario of the proposed work for implementation.

V. PROPOSED MODEL

As we discuss in the above model of the genetic algorithm, the genetic algorithm is initiated with a set of randomly generated population with allowed alphabets in the stream used form application.

Additionally to limit the calculation and termination of the system three different processes are involved here we discuss them first.

1. Value of the function – the value of the function of the best individual is within defined range around a set value. It is not recommended to use this criterion alone, because of the stochastic element in the search the procedure, the optimization might not finish within sensible time;
2. Maximal number of iterations – this is the most widely used stopping criteria. It guarantees that the algorithms will give some results within some time, whenever it has reached the extreme or not;
3. Stall generation – if within initially set number of iterations (generations) there is no improvement of the value of the fitness function of the best individual the algorithms stops.

To improve the performance of genetic algorithm we apply changes in two basic steps first step involves in population distance evaluation using the below given distance function

$$D(x,y) = \sum_{k=0}^{n} |x_k - y_k|$$

Here the most nearest values are evaluated for next generation.

In the next step we works on the termination of algorithm for that purpose we reduce the number of generations using the fitness values. As we know that initially system generates and evaluates all the possible node combination for finding the next generation population values, but most of them are not possible in practical system. Thus the unutilized or impossible node combinations are reduced in this part of the algorithm.

Thus the proposed system can be summarized using the below given steps:

1. Generate initial population
2. Calculate distance function for each generated population using

$$D(x,y) = \sum_{k=0}^{n} |x_k - y_k|$$

3. Remove population having distance less than .5
4. Check for termination condition
5. Perform selection, cross over, and mutation
6. Get new generation
7. Remove impossible sets of nodes
8. Go to step 3

In this section we provide the simple steps of optimizing the genetic algorithm for future use, in the next section of this paper includes the implementation of new protocol for simulation.

VI. IMPLEMENTATION

The proposed technique is implementation of a new routing algorithm for finding best path which is motivated using the article given [1]. The implementation of the proposed model is derived using NS3 network simulator. That is a discrete event simulator to make study for different networks and network protocols. For simulation scripts are written using C++ or the python. This simulator includes about all basic network utilities and protocols for use and provides the simple way to add newly designed protocols in the environment.

For animate the generated simulation using NS3 a common or inbuilt network animator is used “NETANIM”, additionally for results analysis GNUPLOT a Linux utility is used for plotting resultant graphs and results.

Simulation setup: two simulate our proposed work we first setup network environment. Then we simulate and compare our proposed techniques in the three scenarios.

1. Implementation of MANET using AODV protocol and measure its performance.
2. Implementation of MANET using simple genetic algorithm and measure their performance.
3. Implement enhance genetic algorithm and measure their performance.

Parameters	Description
Number of node	20, 40
Mobility model	RandomWalk2dMobilityModel
Simulation time	50 sec
Simulation size	500 X 500
Routing protocol	AODV and Genetic
LossModel	FixedRssLossModel
DataRate	500kb/s

VII. CONCLUSION AND FUTURE WORK

In this study paper we propose an enhanced genetic algorithm. In this paper we discuss our purposed implementation strategy and improvement over traditional genetic algorithm based routing algorithm. In near future we implement this concept using the given network environment step and provide the results of the QoS parameters.

REFERENCES

[1] Hyper-mutation based Genetic Algorithms forDynamic Multicast Routing Problem in Mobile AdHoc Networks, 2012 IEEE 11th International Conference, Hui Cheng, Sheng xiang Yang

[2] PERFORMANCE ANALYSIS OF DIFFERENT ROUTING PROTOCOLS USING NS-3, International Journal of Computer Networking, Wireless and Mobile Communications (IJCNWMC) ISSN 2250-1568,

PRATIK GITE & SANJAY THAKUR
[3] Survey of Multicast Routing Algorithms and Protocols, Pragyansmita Paul and S V Raghavan, Department of Computer Science and Engineering Indian Institute of Technology Madras Chennai 600036 INDIA
[4] ExOR: Opportunistic Multi-Hop Routing for Wireless Networks. Sanjit Biswas and Robert Morris, M.I.T. Computer Science and Artificial Intelligence Laboratory biswas, rtm @csail.mit.edu
[5] Cross-layer Routing and Dynamic Spectrum Allocation in Cognitive Radio Ad Hoc Networks, IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. X, NO. X, XXXX 2010
[6] Real-world performance of current proactive multi-hop mesh protocols, IEEE APCC, Shanghai, China, 8-10th October 2009.
[7] Genetic Algorithms With Immigrants and Memory Schemes for Dynamic Shortest Path Routing Problems in Mobile Ad Hoc Networks, IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS—PART C: APPLICATIONS AND REVIEWS, VOL. 40, NO. 1, JANUARY 2010
[8] A Multi-objective Genetic Algorithm based Approach for Energy Efficient QoS-Routing in Two-tiered Wireless Sensor Networks, 2010 5th International Symposium on Wireless Pervasive Computing (ISWPC)
[9] GENETIC ALGORITHMS FOR OPTIMIZATION, Programs for MATLAB ®Version 1.0User Manual

