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RESEARCH ARTICLE

# An Efficient Routing Implementation Using Genetic Algorithm

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***Abstract— MANET is a new generation network utility and due to their ad hoc nature it keeps attracted for research and development. MANET can defined using unstable network infrastructure, self-organizing network topology and independent node mobility. This becomes obtainable due to their routing techniques; in other terms routing is a backbone for MANET. But due to network load routing performance of MANET is degraded thus some optimization on network routing strategy is required. in this paper we introduces a efficient and effective routing algorithm using the concept of genetic algorithm. the proposed algorithm is promises to provide high QoS parameters with respect to traditional AODV routing protocol. and here we compare the implemented routing protocol using AODV routing to provide the justification of proposed work.***

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

## I. INTRODUCTION

MANET is a self-organizing, infrastructure less network, where each device is able to send and receive data, in addition of independent mobility model. A MANET is a type of ad hoc network that can change locations and configure itself. MANETS are mobile, they use wireless connections to connect to various networks, and this can be a standard Wi-Fi connection, or another medium, such as a cellular or satellite transmission. [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, that deliver information from a source to multiple destinations simultaneously using the most efficient strategy. To deliver messages over each link of the network only once, copy is only created when the links break [1]. 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.
- 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. Multicast provides an efficient communication and transmission, optimizes performance and enables truly distributed applications. 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 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]. As we are working on dynamically changing network problem and optimum route discovery, thus we can involve both kind of routing in our problem domain. 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.

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.

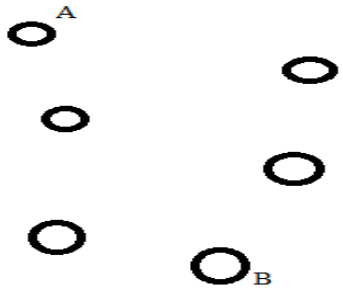


Fig 1 shows the nodes at a time instance

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 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.

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].

## II. ALGORITHMS USED

In this section we discuss about the algorithms which are consumed in our proposed system. We utilize here, genetic algorithm and KNN algorithm the summarized steps and the complete processing of algorithms are described below.

### Genetic Algorithm

Genetic Algorithms works with a set of individuals, representing possible solutions of 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. Calculation of the values of the function that we want to minimize of maximizes.

**Check for termination of the algorithm** – 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** – Among 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.

**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.

**K-nearest-neighbour (KNN) algorithm**

The K-nearest-neighbour (KNN) algorithm measures the distance between a query scenario and a setof scenarios in the data set. We can compute the distance between two scenarios using some distance function d(x,y), where x, y are scenarios composed of features, such that

X={x1, x2, x3…..}

Y={y1,y2,y3…..}

Two distance functions are discussed here:

Absolute distance measuring:

$$\mathbf{d_A(x,y) = \sum_{i=1}^{N} |x_i - y_i|}$$

Euclidean distance measuring: $\mathbf{d_A(x,y) = \sum_{i=1}^{N} \sqrt{x_i^2 - y_i^2}}$

Because the distance between two scenarios is dependant of the breaks, it is suggested that resulting distances be scaled such that the arithmetic mean across the dataset is 0 and the standard deviation is 1. This can be accomplished by replacing the scalars with according to the following function:

$$\mathbf{x' = \frac{x - \bar{x}}{\sigma(x)}}$$

Where the unscaled value is is the arithmetic mean of feature across the data set, is its standard deviation, and is the resulting scaled value.

The arithmetic mean is defined as:

$$\bar{x} = \frac{1}{N}\sum_{i=1}^{N} x_i$$

We can then compute the standard deviation as follows:

$$\sigma(x) = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \bar{x})^2}$$

KNN can be run in these steps:

1. Store the output values of the M nearest neighbours to query scenario Q in vector

r = {$r_1$…...$r_m$} by repeating the following loop M times:

a. Go to the next scenario $S_i$ in the data set, where I is the current iteration within the domain {1……P}

b. If Q is not set or q < d (q, $S_i$): q ←d (q, $S_i$), t ←$O_i$

c. Loop until we reach the end of the data set.

d. Store q into vector c and t into vector r.

 

2. Calculate the arithmetic mean output across r as follows:

$$\bar{r} = \frac{1}{M}\sum_{i=1}^{M} r_i$$

3. Return r as the output value for the query scenario q

In this section we described the two best fit algorithms which is selected for hybrid them and finding the possible solution using the profitable aspect of the given algorithm. Here we provide the brief introduction about KNN algorithm and genetic algorithm steps which are used in our proposed model (proposed algorithm). In next section we provide the algorithm for implementation.

## III. PROPOSED MODEL

As we discuss in the above section about genetic algorithm, the genetic algorithm is initiated with a set of randomly generated population with allowed alphabets in the stream used form application here the number of nodes and their corresponding node alphabets are used in our proposed protocol.

Uses of the genetic algorithm in search problems are a traditional way of computing. In genetic algorithm, algorithm process all the possible conditions and return the most optimum or fittest values in each step of execution or generation. To limit calculation and termination of the genetic algorithms three different processes are involved or suggested which is described below in brief.

1. **Value of the function** – the value of the function of the best individual is within defined range around a set value.
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 to peak or not;
3. **Stall generation** – if number of iterations (generations) set initially there is no improvement of the value of the fitness function of the best individual the algorithms stops.

in addition of that the number of generated population in any genetic algorithm is also required to reduce, by reducing these population the execution of algorithm is becomes faster than traditional execution time, so 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 termination of algorithm is done by reducing 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:

| |
|---|
| Input: number of nodes |
| Outcome: routes |
| Process:<br>1. Generate initial population<br>2. Calculate distance function for each generated population using<br>$D(x,y) = \sum_{k=0}^{n} \lvert x_k - y_k \rvert$<br>3. Remove population having distance less than .5<br>4. Check for termination condition<br>5. Perform selection, cross over, and mutation |

 

6. Get new generation
7. Remove impossible sets of nodes
8. Go to step 3

The proposed algorithm is described in the above given table; the proposed algorithm is a hybrid algorithm which is designed using genetic algorithm and KNN algorithm. Where the processing steps are inherited from genetic algorithm and the distance measurement and node elimination process is derived using KNN algorithm.

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.

## IV. IMPLEMENTATION

To simulate the research work we working around various software simulation network tools, and we found the NS3 network simulator which is a discrete event network simulator where all the participating devices can be visualize by the nodes and the corresponding network utilities can be installable. Moreover it simulation required additional script writing for performing the experiments using python or using C++ scripts. User has freedom to select their own language for scripting. Once network script is compiled and executed some additional files are generated to get the network information for performance evaluation and animation of network and created scenario. For visualization NETANIM can be used and for performance graph and results GNUPLOT is a good utility for use.

**Simulation setup**

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

| **Parameters** | **Description** |
|---|---|
| Number of node | 10,20,30, 40,50 |
| Mobility model | RandomWalk2dMobilityModel |
| Simulation time | 50 sec |
| Simulation size | 500 X 500 |
| Routing protocol | AODV and Genetic |
| Loss Model | FixedRssLossModel |
| Data Rate | 500kb/s |

Network simulation having two most important parts first parameters required for network simulation and second the simulation of network scenario for performing the experiments and results evaluation.

1. Implementation of MANET using AODV protocol: in this network scenario we implement a network using AODV routing protocol over variable number of nodes in network.
2. Implement enhance genetic algorithm and measure their performance: here we implement and modify the network protocol and implement genetic algorithm in traditional AODV protocol.

 

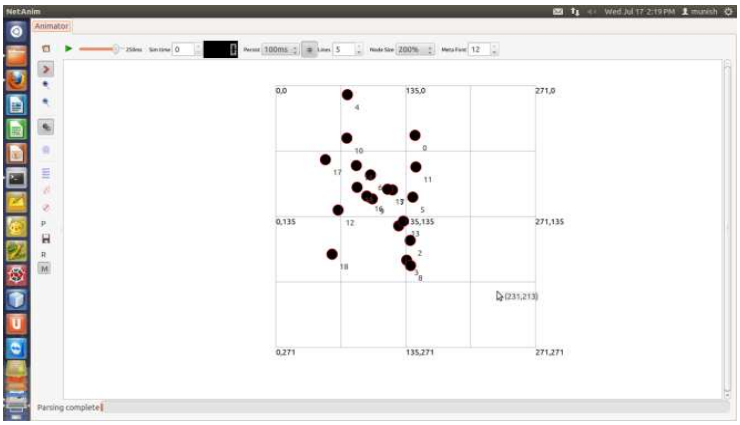

Fig shows the basic animation

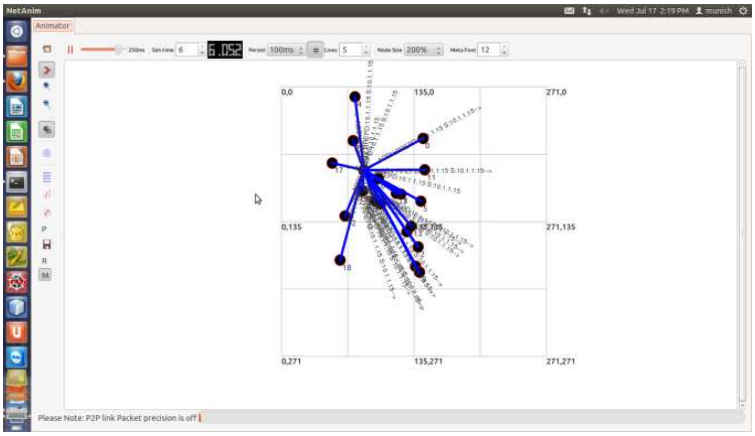

Fig shows the communication between nodes

After implementation of the network scenarios we found the above given screen on out NETANIM simulator.

## V. RESULTS

This section of presented paper provides the performance analysis of the proposed routing protocol with respect to the AODV routing protocol. For performance analysis we use more than one performance parameters.

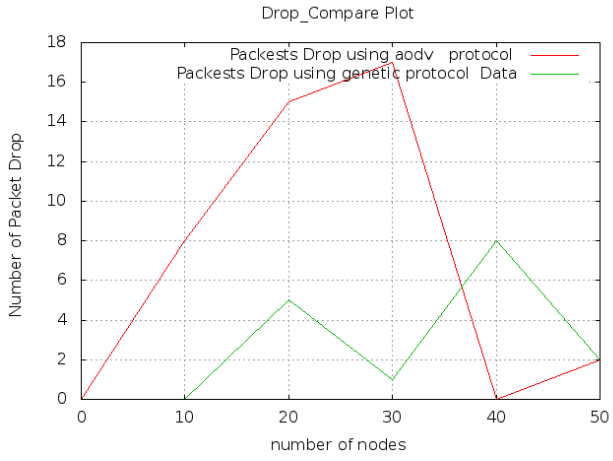


Fig shows packet drop ratio

 

From the above given screen shows the drop ratio, of both protocols, packet drop ratio is estimated by the below given formula

$$packet\ drop\ ratio = \frac{total\ drop\ packets}{total\ sent\ packets}$$

Estimated PDR (packet drop ratio) is provided using the above given figure.

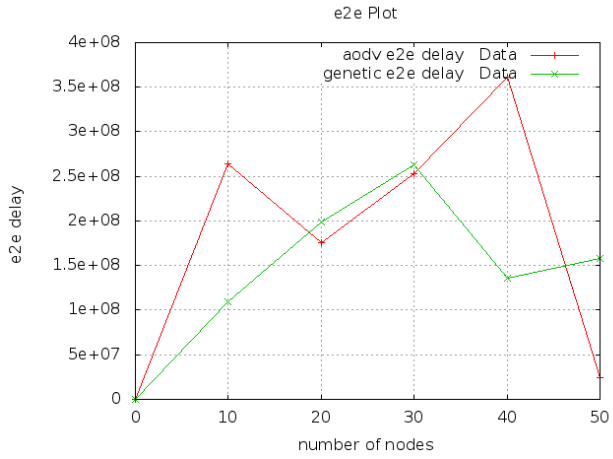


Fig shows the end to end delay

Total time difference between send and receiving of any data packets is known as end to end delay. Fig shows the end to end delay between both protocols due to analysis we found that the PDR ratio of genetic algorithm and end to end delay in genetic algorithm is acceptable for our proposed model and experiments reflects higher performance then AODV protocol.

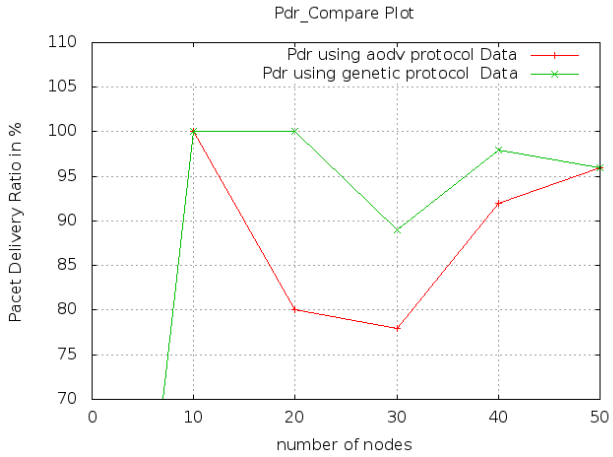


Fig shows the packet delivery ratio

Packet delivery ratio provides information about the performance of any routing protocols. Where PDR is estimated using the formula given

$$packet\ delivery\ ratio = \frac{total\ delivered\ packets}{total\ sent\ packets}$$

 

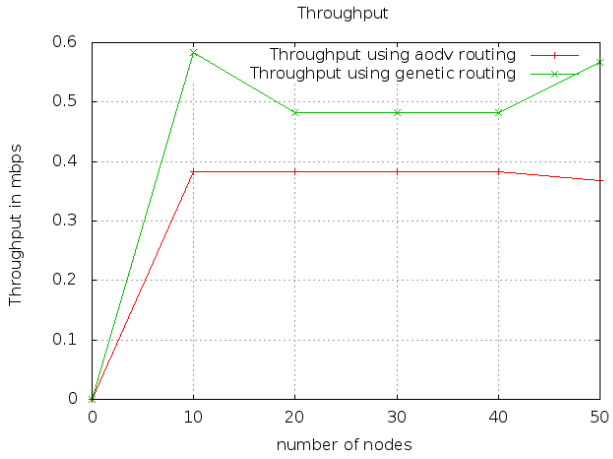


Fig shows the throughput

Throughput provides the efficiency of the system and given using the above given fig. after evaluation of the performance parameters we can see that the overall performance of the proposed genetic algorithm is much efficient than the traditional routing protocol AODV.

In the next section of this paper we provide the conclusion and the corresponding future research work which is necessary is discussed.

## VI. CONCLUSION AND FUTURE WORK

In this presented paper we provide the complete research work and there implementation using NS3 network simulator and visualize using the NETANIM tool. Here given simulation is based on two different routing technique in MANET using simple or traditional AODV routing and an enhanced routing using genetic algorithm and KNN based routing technique. And results are evaluated after performance analysis we found that genetic algorithm based routing protocol simulate better performance than traditional routing.

In near future we provide a new routing technique using same concept and which promises to provide efficient routing and security over black hole attack too.

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