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ARTICLE

A SECURE GA APPROACH IN TREE BASED MUTICAST NETWORK

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ABSTRACT

Multicast routing is the process of sending data from one or more sources to many destinations. In MANET, structure of the network may change frequently due to the movement of the nodes. Hence routing affords multifarious issue which has led to development of many diverse routing protocols for MANETs. To achieve high efficiency, it is mandatory to minimize path delay due to blocking, and the cost of the path tree to reach destinations. Multicast Tree Optimization (MTO) problems are usually difficult to solve and are known as NP-Complete problems. The Genetic Algorithm (GA) has been proven to be an efficient technique for solving the MTO, because of its well defined chromosomes and genetic operators, which are the key characteristics of the GA to determine its performance. GA is a heuristics combination, which depends on an actual state of the network and will select paths in such a way to maximize the routing metric. The security metric is also including using genetic algorithm to prevent from security attacks. A proposed work leverages the advantages of Newton's interpolation method to implement the key chaining for MANET. The simulations are carried out for the different parameter such as control overhead, end to end delay, packet delay and average node density. With the performance enhancement and comparison are performed through extensive simulation. It is proved to be an efficient encoding scheme of the reconstruction of the multicast tree topology and the simulation results demonstrate the effectiveness of the sGenMAODV compared to the MAODV protocol.

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INTRODUCTION

KEY WORDS
MANET, Multicasting, path tree, Genetic Algorithm, key chaining

Recently Multicasting routing has various protocols proposed, in this way many multicast protocols have been Evaluated and proposed. MANET multicast protocols can be characterized by how they proliferate information as mesh-based or tree-based [1]. While tree-based conventions spread information over a tree traversing all multicast bunch individuals, in mesh based conventions a subset of organization hubs (mesh) is answerable for sending information to all multicast recipients. A few of the current routing convention are Protocol for Unified Multicasting through Announcements (PUMA), Core Assisted Mesh Protocol (CAMP) Forwarding Group Mesh Protocol (FGMP), Dynamic Core-Based Multicast Routing Protocol (DCMP) and most usually utilized On-request Multicast Routing Protocol (ODMRP) are protocols of mesh based conventions[2]. Multicast Protocols, for example, Multicast Ad-hoc On demand Distance Vector (MAODV) are tree based conventions, In this multicast routing, Increasing traffic load varieties cause confined connection link congestion, and optimizing the route that bring about potential execution issues. Quality of Service (QoS) based multicast directing and different issues identified with Steiner trees.

Genetic Algorithms are search based algorithm reliant on natural evolution models. The Search space includes population of individuals' nodes from which it represents the best possible routes. The fitness value is assessed for each route in order to achieve optimal route from many possible routes. The methodology of the GA approach is to investigate the pursuit search space and to find a superior ideal solution for the problem definition. The accomplishment of the calculation is ascribed to different components such as robustness, advance search capability, capacity to join with other heuristic methodology, for example, discrete or continuous search space and linear or non-linear constraints,

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Route optimizing is significant factor for designing route traffic that are utilized to localized congestion, forward data packets and routing tables need to building in a optimize manner. This incorporates packet loss; packet delay and other link utilize values within the nodes. The fundamental point is to have minimized the cost of the route and effective linkage in the network. The current methodology manages NP complete issue in which communication through the multicast tree take place through packets. In this paper manages strategy for getting secure path exchange, latency, control overhead that respects advance optimize routes and secure way trade through Newton's interpolation method for secure key exchange and Genetic Algorithm for QoS prerequisites utilization.

Mathematical analysis and process

In Genetic Algorithms are search based algorithm reliant on nature of evolution process it represents the best possible routes. Each time it produces new offspring through probability which is relative to the nature of the comparing arrangement. In every generation, strings that represent to arrange with great properties to have a higher opportunity to get by the others. The crossover picks a couple of strings, which splits up their quality grouping indiscriminately places, and exchange the hereditary data. The mutation process represents new hereditary material by randomly choosing and changing straightforward genes.

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If the size of population and also, in every algorithm the best generation are set to 100 and 1000 separately and the parameters for the computation of the proposed algorithms are set to mutation probability Pm = 0.05 to 0.1 and crossover probability Pc = 0.4 to 0.5.

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Shortest path trees (SPTs) and multicast trees (MCTS)

The two principle way to deal with optimizing the multicast routing issues is Shortest Path Trees (SPTs) and Minimum Cost Trees (MCTs). A undirected spanning tree G = (V, E), V = {v1,v2,v3, ...vn} is the vertex set , and the E = {e1,e2,e3, ... em} is a set of edges that is associations between these vertices of G. Let W = {w1,w2,w3, ... wm} stands to the weight or cost of each edge and confined to be a positive number. The objective of SPT calculations is to build a minimum cost shortest path in the multicast tree from the sender to its recipients

The MCT approach means that the complete expense of the multicast tree is need to reduce. MCT approach also depends on the base Steiner tree issues, which is NP-Complete. The cost tree with minimum edge can be found by arranging all the weight in the ascending order, choosing each edge in turn and, going along with it to the tree, when it doesn't make a cycle. here involved less number of forwarding nodes while compare to SPTs

METHOD

This technique is to find the minimum cost multicast trees with best the fitness value. The problem or issue is to encode into a set of chromosomes (strings), and each string in multicast tree will be allocate a fitness value. Here in this paper we are utilizing protocol named Multicast Ad-hoc On-demand Distance Vector (MAODV) protocol, which is tree base multicast routing protocol.

In MANETs, designing a multicast routing protocol is a challenging task due to its limited link, path constraints and node mobility. A new dimension to the multicast routing problem is the construction of a optimized tree structure or minimum cost tree that supports QoS characteristics such as delay, jitter, throughput, etc. which are the essential requirements for modern multimedia applications in multicast communication. Multicast Tree Optimization (MTO) problems are usually difficult to solve. The GA has been an efficient procedure for giving solution to MTO, because of its well defined chromosomes and genetic operators, which are the key characteristics of the GA to determine its performance.

In MAODV, it utilizes a tree based path, which contains a bunch of relay nodes to convey information in form of data packets conveyed by the source to multicast recipients. This set of relay nodes are selected by the MAODV itself between the source and the receiver. Nonetheless, these trees are not ideal as far as number of sending or forwarding nodes which are chosen, acquiring a higher control message overhead, which, in turn, reduces the data delivery. The concept of minimum cost trees is to attempt to lessen the expense of the multicast tree by decreasing the quantity of connections(links) which are needed to associate from sources and destinations. This is needed by choosing joins in the tree which are valuable to countless receivers. The issue of finding a multicast tree with minimum cost is notable as the Steiner tree issue; to achieve this, a new encoding scheme sequence and topology encoding is introduced. It is proved to be an efficient encoding scheme of the recreation in topology of multicast tree and the simulation results show the improvement of the GenMAODV compared with the MAODV convention.

Basis for genmaodv

The augmentation of multicast is Ad-hoc On-demand Distance Vector Protocol (AODV). In each multicast group a tree structure and the group member is coordinated that first develops the tree with the group leader, and in order to broadcast Group Hello (GREP) messages periodically, need to maintain group tree in the network. Here, every node maintains has three tables,

1. unicast route table
   In this table, it stores the location of the next hop for unicast traffic.
2. multicast route table
   In this table, for each multicast group, it stores the next hop information for the tree structure. Like group leader or group member, every node in the group should maintain to keep up its own identity and associate with either downstream or upstream direction.
3. Group route table
   In this table, it stores the next hop address of group leader and towards the group leader.

The detecting of broken links on the active nodes, route to multicast node can be process in MAC layer. Each node will check to find the next hop information in order to forward packets in the multicast tree through multicast route table. For multicast tree construction RREQ, RREP and MACT messages are used. Initially a node sends a join flag RREQ-J when needs to join the multicast group or when it is not a tree member. It makes an entry and identify node in the multicast route table.

Multicast Route Activation (MACT) is utilized for joining a branch to the tree. Subsequent to sending RREQ-J the source node stay for a particular time RREP-J. If received it, sends MACT-J towards upstream node and adds the address of new next hop information to the multicast routing table. If not received any RREP-J, the mentioning source node turns into the group leader to keep up the gathering number (sequence) and tree structure. Multicast tree support incorporates Periodic Group-Hello Propagation, Neighbor Connectivity Maintenance, Group Leader Selection, Membership Revocation and Tree Merge.

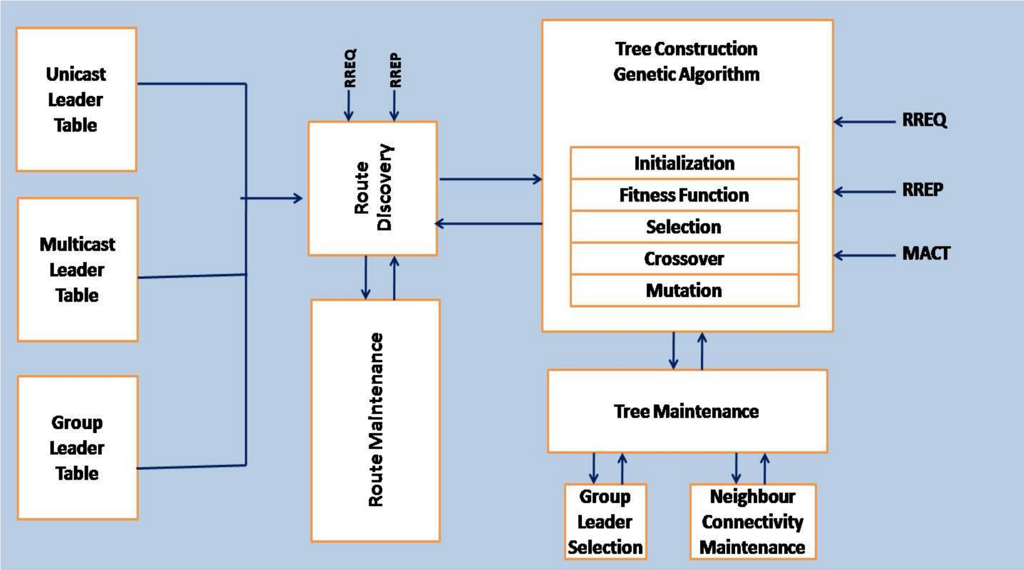

Fig. 1: Architecture of GA optimize with MAODV routing protocol.

The group leader should intermittently broadcast Group Hello message (GRPH) to the whole network to indicate the existence of the group and its status. group leader table is updated all the nodes as well as the route reaching towards the GRPH message. when the downstream node of a connection in the tree understands that the connection is broken by not accepting any transmission messages from that neighbor. Tree neighbor availability is repaired and maintained.

If a connection link breakage is recognized, the downstream hub erases the next hop information in its multicast route table and sends RREQ-J to locate another branch. If requesting source node to change its group information with the help of local repair message, then at this point GRPH is send with an update flag GRPH-U to its downstream node. Where next hop information will get data packet informing to the source node to start a new discovery. Thus, to setup a multicast tree for an unidentified multicast group, the group leader request its group members through broadcasting RREQ/RREP control messages to the whole network. Every node receiving these messages chooses one with the optimal route.

Secure GA Model

This procedure is to discover the minimum cost multicast tree with best the fitness value[4]. The issue is encoded into a bunch of strings (chromosomes), and each string speaks to a multicast tree and is relegated a wellness fitness value. The development of an advanced or optimized route in the MAODV with a base number of sending nodes is done in the accompanying way.

Initial Population

In the MAODV, the nodes in the organization structure a tree, and the quantity of spanning trees on a total chart of 'n' hubs is nn-2 as indicated by Prufer's verification of Cayley's hypothesis..

Encoding

This part presents an encoding plan used to improve the directing proficiency in a GA. In the GA, the main basic task is to encode trees, Generally, the encoding plans, use edge encoding, vertex encoding, and both edge and vertex encoding. However, the GA dependent on these encoding plans doesn't save area; while transforming one component of its vector causes a radical change in its individual tree topology. The encoding plan is called topology encoding and the related with crossover and mutation.

Fitness Function Evaluation and Selection

The Fitness function is estimated by how well the chromosome finds an answer. Just a fitter chromosome yields offspring in the future. The sub chart of G can be communicated utilizing a vector x = {x1, x2, x3, ... xm} where every component xi can be characterized as follows

$$x_i = \begin{cases} 1 \; if\ edg\ e_i\ is\ selected\ in\ the\ subgrapgh \\ 0 \; otherwise \end{cases}$$

In a graph G, consider the set of spanning tree is T. the evaluation can be devised as

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$$f(x)_{min} = \sum_{i=1}^{\infty} \{w_i x_i | x \epsilon T\}$$

Where w = {w1, w2, w3.............. wm} represents the cost of each edge.
m=Number of nodes in the sub network.
The cycling cycle proceeds until either multicast tree with minimum cost is found or iterations is reached to the maximum extend. This method applies repeatedly until the selected parent node is reproduced.

Crossover

The crossover operator modifies the chosen components to form new segments to be assessed in the future generations. The plan of operators in this encoding scheme is significant, in light of the fact that GA will applied to enhance adequacy and effectiveness. The encoding plan utilize here, contains two chromosomes; the operators for this encoding are more confounded than those for single chromosome codes.

Mutation

Mutation is a important operator in genetics used to keep up hereditary variety from one age of a populace of chromosomes to other. The exemplary illustration of a mutation includes probability of changing a sequence of a bit from its original state. This arbitrary variable tells whether a specific bit sequence will be changed. It accomplishes a decent territory so just a little change happens in the nodes on the tree after crossover. The reason for change in a hereditary calculation is to permit the calculation to dodge neighborhood minima by keeping the number of inhabitants in chromosomes from getting excessively like one another. At the point when a change happens, a vertex is arbitrarily chosen on the tree and another tree(new) is developed there.

Key chaining

During the process of selection, unauthorized node can intervene and disturb the whole network by passing incorrect information, blocking the content and other services partially or completely. Key chaining is one of the important security framework for network building, other framework are Security association and Distributed Key management [9].

In this Key Chaining method, Network interpolation is used that is based on interpolating polynomial degree and recognized by Lagrange formulae. Newton's forward difference and Newton's backward difference are the two types of interpolation method that support data that one can slowly build the help information without re figuring what is now registered.

The Forward difference method helps in to determine new routes in all best way to it reaches destination node. This method updated with key share generated using the interpolation method that all are encrypted by intermediate nodes values that cannot be viewed by other nodes. These asymmetric key shares from the Newton's forward table which are used to generate polynomial functions.

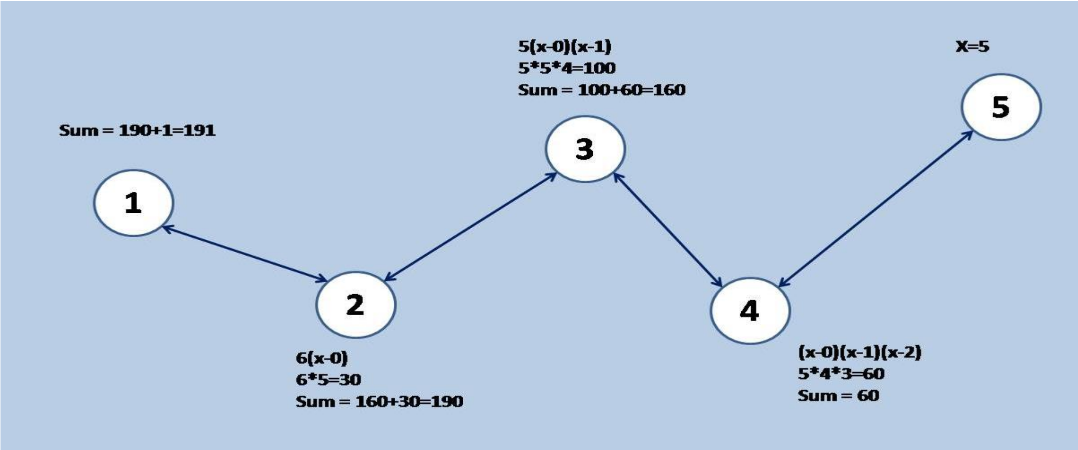

Fig. 2: Secure Key chaining in GenMAODV.

The objective hub begins key affixing in the wake of accepting a forward method, in reverse methods refreshed with key offers table backward request. The key offers are scrambled by open keys of separate middle nodes. These qualities are contrasted and old qualities from node table and calculation is summoned to refresh way and to give the symmetric key to source node.

The [Fig. 2] shows key share principle that share encrypted values among the intermediate nodes. The Values generate from key share compared with old values key shares table and updates path till it reaches to source node.

Key chaining calculation

Stage 1: Generate a retrogressive backwards method with key offers as surrendered
Stage 2: Generate a polynomial capacity with the assistance of gathered key shares.1 + 6(x-0) + 5(x-0)(x-1) + 1(x-0) (x-1)(x-2) + 0(x-0)(x-1)(x-2)(x-3) x3 + 2x2 + 3x + 1
Stage 3: Calculate f(x) for a given random estimation of x
Stage 4: For example, on the off chance that x=5, at that point f(x)=191
Stage 5: Encrypt x by utilizing the public key of source hub
Stage 6: Send in reverse subterranean node to source hub
Stage 7: Compare key offers an incentive at every single intermediate node.
Stage 8: on the off chance that qualities are equivalent, at that point assess conditions at intermediate Nodes
Stage 9: For example, Node (hub) 4 [Fig. 2] value= (x-0)*(x-1-)*(x-2) =5*4*3=60.
Step10: Calculate sum=sum + value
Step11: Encrypt aggregate by utilizing the public keys of individual middle hubs.
Step12: Repeat ventures from 8 to 11 to calculate complete sum.
Step13: Deliver whole to source hub

Thus with the help of random generated value 'x' and its sum carried out till the source hub by backward method. The amount of all middle qualities should be equivalent to symmetric key qualities that are created straightforwardly by source hub. Essentially the proposed work centers around way based key rather than a solitary hub.

RESULTS AND DISCUSSION

In this paper, Performance is simulated using NS-2.34 software which is most open source simulator for research. This Simulator consist of backend c++ code and for accessing need TCL scripting language. Along with this patch of MAODV and Genetic Algorithm generic code is added. Simulation results show two protocols MAODV and sGenMAODV subjects to multicast group and mobility. In this paper, the senders are chosen at random from the multicast group. The number of sources and receivers are set as five and twenty respectively, in all simulations except when varying the multicast group size. The GA parameters for the computation of the proposed algorithms are set to mutation probability Pm = 0.05 to 0.1 and crossover probability Pc = 0.4 to 0.5. Continuous and efficient path is obtained and the data is transmitted without any delay and with very high delivery ratio. Results show that sGenMAODV has a high success rate packet delivery ratio, low latency when compared with MAODV and sGenMAODV protocols. Results show that sGenMAODV performs better than existing protocol MAODV, more than 90 nodes are formed to compare the performance of the two protocols.

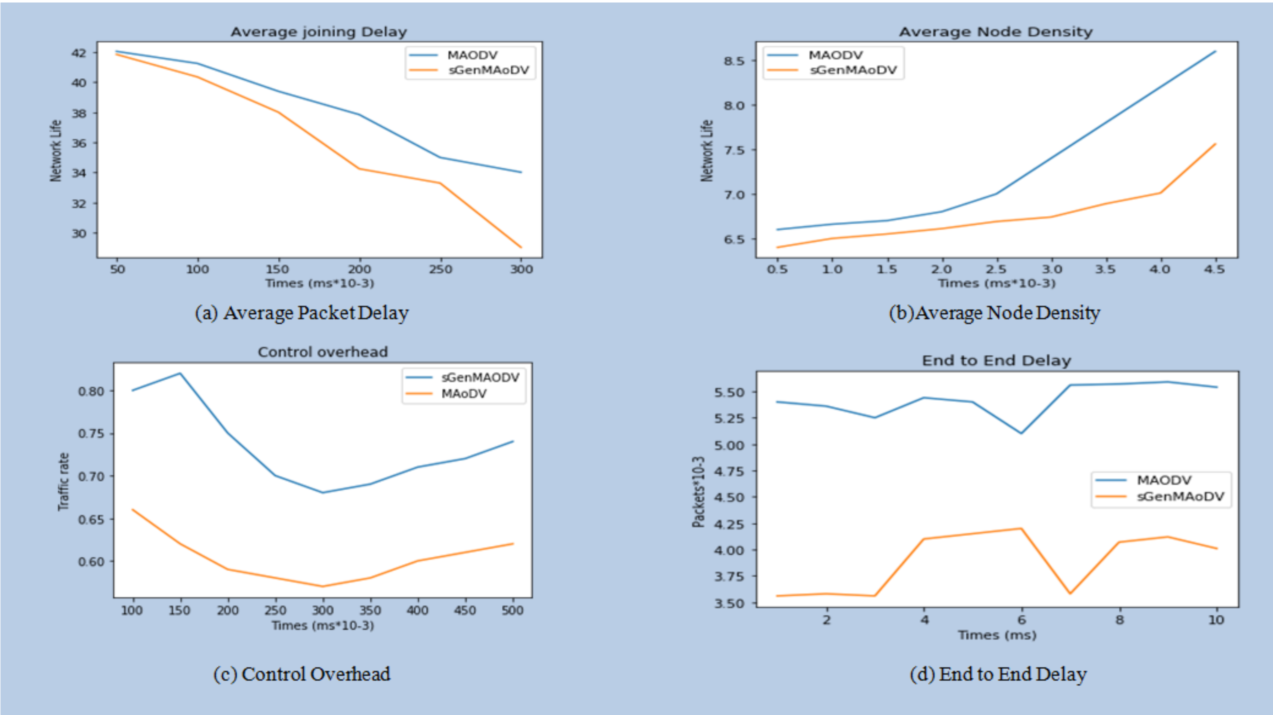

Fig. 3: Simulation results graph of average packet delay, Average Node density, Control overhead and end to end delay.

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Average packet delay

In this simulation, average packet delay is sum of times taken by the successful data packets to travel from their sources to destination divided by the total number of successful packet. The average packet delay is measured in seconds. In [Fig. 3a] shows the comparison of two protocols using NS-2 simulator and shows that average delay of SGenMAODV is less when compared to protocol MAODV.

Average node density

In this Simulation, the node density impacts routing evaluations since it determines, together with the mobility model, how many neighbors a node has. In [Fig. 3b] shows the average node density of sGenAODV is reduced when compared to other protocol.

Control overhead

In this simulation, the control overhead is calculated as total number of control packets needed to establish a stable route from source to the multicast receiver. In [Fig. 3c] the control overhead of sGenMAODV is improved when compared to MAODV protocol.

Average end-to-end delay

In this Simulation, End-to-end delay is calculated the time taken for a packet to traverse across a network from source to destination. It is average time of the whole network passing a packet. In [Fig. 3d] shows that the End to End delay of sGenMAODV is reduced when compared to MAODV protocol. This signifies how proficient the fundamental directing calculation is, on the grounds that delay basically relies upon optimality of way picked

CONCLUSION

In Tree based multicasting is a challenging task due to its limited link, path constraints and node mobility. MAODV is the tree based existing routing protocol which contains a bunch of relay nodes to convey information in form of data packets conveyed by the source to multicast recipients. Genetic based with secure key exchange makes MAODV more optimal. The simulation results show that sGenMAODV provides better results for average delay, average end-to-end delay, control overhead, average node density in different node speeds and also for different number of nodes. Genetic Algorithm find the solution space in getting of optimal route and newton's interpolate method helps in key chaining mechanism for secure communication. Thus sGenMAODV protocol provides enhance communication when compared to existing protocol MAODV

CONFLICT OF INTEREST

None.

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None.

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