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An evolving Semi graph-based Algorithm for Quality of Service in MANET

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Abstract*: *Quality of service is an essential term in Mobile Adhoc network was several mobile nodes are interconnected to frame a network without the background control structure. Multimedia technology along with the mobile technology based on the implanted application area requires a strict quality in service based on throughput, delivery ratio and delay. The limitations like connectivity, scalability, and routing and topology control are the major issues faced by Mobile Adhoc Network. To overcome these issues and to increase the quality of service in the MANET semi graph-based algorithm was implemented to frame a network link between the mobile nodes in the MANET. Semi graph algorithm provides maximum possible shortest routs with lesser communication cost. It limits the packet dropping due to circular shift in the network. The performance of the semi graph model is compared with the graph model and performances have been compared.

Index Terms*: *Quality of Service, MANET, Semi graph, Edge Dominant set, Connected Edge Dominant Set.

I. INTRODUCTION

MANET's also known as mobile ad-hoc networks are a network where mobile nodes combine to form a temporary ad-hoc network. The MANET's do not require any infrastructures. The MANET's do not have any centralised governing body such as the router to discover new nodes and to maintain communication between nodes in the network. The numbers of routers between two particular nodes may increase or decrease depending on the mobility of nodes in ad-hoc network. These are temporary networks set up to solve complex communication links that occur during certain conditions. The nodes in MANET are ubiquitous, powered by battery source and mobile. The nodes in network communicate and arrange themselves accordingly either as a standalone network or as a part of a large network such as the internet. MANETs are popular since they posses' distinct advantages compared to other networks such as easy deployment, less configuration, does not require a central authority network to govern nodes in network. The distinct advantages make MANET ideal solution to implement in emergency conditions such as during war, natural calamity and when the number of users in the network increase suddenly. The mobile devices in network arrange themselves in coordination to establish communication. MANETs form with IEEE 802.11 Wi-fi protocol which can provide Ad-hoc networking facility. The MANET is a viable solution where there is no adequate infrastructure and where there is the minimal resource of infrastructure. Due to the advantages as mentioned above, MANET's apply in military, private and government firms. Furthermore, vehicles with built-in mobile devices use MANETs to retrieve information regarding weather, traffic and journey time. MANETs have salient features such as dynamic topology where are the nodes in the network are free to move anywhere arbitrarily making the network topology and routing change at a rapid pace. The bandwidth for data transmission is not limited by the user but set by mobile devices. The data transmission rate and node operation limit by battery energy source. The battery-powered mobile nodes are small in size which makes them prone to physical abuse than fixed cable networks. These mobile devices can be easily hacked, cloned and can be physically attacked easily. MANETs typically apply in applications such as vehicular network, personal area network, and in transportation systems. In transportation, MANET's help identify and evaluate different paths between source and destination. Since the nodes in the network are dynamic, the link between the nodes at times discontinues making data routing between nodes in the network difficult. The mobility in the network is directly proportional to the level of discontinuity hence the nodes the network should frame in such a way that there exists at least one routing path between nodes. The routing path combination between the nodes is often determined by the type of topology that exists between the nodes in the network. The mobility pattern and energy constraint use to determine the type of routing and topology employ to setup a mobile ad-hoc network. The topology should also be dynamic since there will be frequent changes among nodes and any node at any time may act as router or mobile node to forward data packers between nodes.

II. LITERATURE SURVEY

MANET is a group of mobile wireless nodes, without using present facilities simultaneously creating a communication network. MANET is distinguished by the topology of the network that is highly dynamic and energy limited. MANET's efficiency depends on the energy management, its topology and its control protocol. The flexibility and scalability of the performance of the network can be enhanced by using clustering strategy. Here a new clustering strategy is proposed to perform conservation of energy and management of topology.

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The clustering strategy is a Genetic Algorithm and Simulated Annealing based clustering strategy [1]. In environments where the Mobile Adhoc Networks is present, the dependence on focused techniques is unreachable; the goal of the attack recognition attempt is to generate deduction and interaction methodologies that can identify very complicated attacks in several stages. Here research is carried out on the ability of a network to retrieve from an attack. The ability depends upon the algorithms modified conventionally that can be obtained from the graph theory using a novel framework that is agent based. The framework that is agent-based is a group of collective agents able to collect raw packet data, metadata comparison to a knowledge base and the decision production [2]. The main critical issues in MANET that affects the network's performance are bandwidth, connectivity and transmission power. It is necessary to analyse the transmission power utilisation because every single node is functioning with battery power limited. The node's transmission power relation with the connectivity is high. Due to random motion of nodes, the network may be interrupted and get disconnected. So partition in networks produces additional overheads that node's battery power is consumed for many other processes such as new route learning and partition detection in networks. K-connected MANET delivers reliability very high, tolerance for route failure and utilisation of power can be regulated. Here the analysis of the transmission power, partitions in the network in K connected MANET, and the architecture of cross-layer is presented. Using Matlab simulation experiment is done [3].

Mobile Adhoc Networks (MANET) provides a new method of wireless networking that imposes many challenges for monitoring, control and management. For the operations-control-management functionality of Mobile Adhoc Networks, security is taken into account. The most important and vital part of security is maintenance and confidence establishment. The Mobile Adhoc Network framework here proposed has two main components a) distribution of trust document b) computation of distributed trust. The distribution of trust document describes the scheme of trust document distribution based on swarm intelligence. The computation of distributed trust describes some schemes for distributed trust computation. In this way, the phase transitions that can appear in a MANET are demonstrated. The presence of such phase transitions and these phase transitions analysis are linked to reliable cooperative games. The reliable cooperative games will constitute a general framework to analyse numerous problems for MANET [4].

Here a set of protocols that provide routing method and distributed planning for MANETs. The advanced set of protocols comprises three protocols that increase the lifetime of the network and provides scalability. The first protocol that is the fast distributed connected dominating set creates the virtual backbone by creating a quick dispersive hierarchical algorithm that identifies in the graph of the network that is the dominating set that is connected. The virtual backbone considers the limited energy of the node, mobility of the node and node's pattern of traffic. The second protocol describes a maintenance protocol that is distributive and maintains the hierarchical algorithm's integrity. The third protocol uses a novel fuzzy logic controller with path selection which can be used in any present link state routing protocol [5].

In wireless mobile adhoc networks, the capacity of transmission is limited by the continuous transmissions with mutual interference among the nodes. A graph theory method and the existing methods for calculating the capacity of transmission for the graph theory given is proposed here [6].

Cognitive Radio Technology has a remarkable influence on mobile ad hoc networks. Here the issues in routing and topology control in Cognitive Radio- Mobile Ad hoc Networks are discussed. Here a cognitive topology control scheme with the prediction based and distributive nature to provide the capability of cognition to routing in cognitive radio mobile ad hoc networks. The prediction based topology control is a module with cross-layer sliding again and again between routing and the cognitive radio module. It uses the presence of cognitive link with the prediction that knows interference that can occur in primary users to predict the duration available for links. The topology's dynamic changes are captured bythe predictive based cognitive topology control and create a topology that is reliable and efficient topology aiming at a frequency that has mitigating and rerouting frequency thus improving delay and throughput [7].

Cooperative Communication has got much interest in window networks. Most of the works based on Cooperative communications are concentrated on physical layer link level issues. Conversely, the effects on cooperative communications on upper-layer issues in network level like control of topology, capacity on routing and network are ignored completely. A capacity-optimised cooperative control scheme of topology with the upper layer capacity of network taken into account to enhance the capacity of the network [8]. The mobile ad hoc networks depending on the cooperative communications play a major role in security issues, network performance issues. Here the issues in topology control and authentication are mainly focused. By using the topology control schemes, throughput is increased. Here both the authentication and topology control scheme is considered. Especially using the authentication schemes in the upper layer and physical layer, the effective throughput is analysed. To enhance the network's throughput, a joint authentication and topology control scheme is proposed. Joint authentication and topology control are designed as a discrete random probability distribution optimisation problem. In the discrete random probability distribution optimisation problem, the tracking convergence property and the convergence rate are mathematically proved [9]. In Mobile Ad hoc Network, Quality of Service signalling protocols is more dangerous to attacks. In particular, the network performance is severely weakened by a class of denial-of-service attacks. To improve the network performance, a quality of service signalling protocol that is distributive and resistive to a class of denial of service attacks. For real-time traffic, this signalling protocol provides the better quality of service, and at the medium access control layer, it formulates mechanisms. The mechanisms include available bandwidth sensing, policing of

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traffic and monitoring of rate and all of these are performed by the mobile nodes in a distributed manner. The signalling scheme fulfils the requirement of the per-flow state by the signalling protocols by accomplishing a relationship between these signalling protocols [10].

Mobile devices especially using Mobile Ad hoc Networks are battery powered with energy supplies limited. Topology control is an optimistic approach by which energy is conserved by either reducing each node's transmission power or in the entire network, safeguarding the energy efficiency routes. However, between the energy efficiency of the nodes and topology routes, a trade-off occurs. Besides these, to maintain the topology due to the mobility of nodes, it can take the considerable amount of energy. Here for mobile nodes, an adaptive control protocol of topology is proposed. This adaptive control protocol enables every node to determine to support either conserving its energy or energy-efficient routing. Also for mobile nodes, it can extremely reduce the power of broadcasting of beacon messages [11].

In topology control of mobile ad hoc networks, the transience of mobile nodes is a great challenge. To overcome the mobile node's transitory nature, topology control algorithms with k-edge connected has been proposed to create robust technologies for mobile networks. However, using the k value evenly in any graph for topology control algorithms localised is not effective due to the movement of nodes at different speeds. Moreover, it is supposed to the determine the value of k priory by the present k-edge connected topology control algorithms. However, the movement of the speed of nodes is not able to be determined. Hence these algorithms are not practically used in mobile ad hoc networks. To incorporate the k-edge connected topology control algorithms in mobile ad hoc networks effectively, a dynamic method is proposed. By using the proposed method, for each local graph, the appropriate value of k can be determined based on the local information, thus assuring the whole network's required connectivity ratio [12].

A new method of routing based on hyperbolic transformation and greedy advancement is proposed. Bit addressing is proposed using a connection graph that has the tree-like structure to overcome the local minimum problem. Over the graph, the new distance metric is equal to hops number of transitions rather when compared to the present hyperbolic address spaces. For a given node configuration, an algorithm for allocating bit addresses of variable length is proposed. For a new advanced routing method, acomparative performance analysis is performed [13].

The main issue in Medium Access Control in Mobile Ad hoc Network is the collision and potential contention within the mobile hosts. The main objective is to resolve these potential contention and collision to efficiently utilise the radio spectrum. The existing methods use the power control and multiple channels to enhance the performance of mobile ad hoc networks. Here the solution to incorporate the multichannel medium access and power control concepts together in the design problem of MAC are investigated. The protocol proposed has the following features i) to allocate channels to mobile hosts an on-demand style is followed ii) the required number of channels does not depend on the topology of the network and degree iii) For mobility of hosts, the proposed protocol flexibly adapts iv) there is no requirement of clock synchronisation form v) to overcome frequency reuse, power control is used [14].

In mobile ad hoc networks, there is an increase in the quality of service requirement regarding delay. So topology control should be considered in the environment with delay constrained to meet the requirements of delay. Here the problem of delay constrained topology control is considered, and both delay and interference are considered. A cross layer distributed algorithm called topology control algorithm that is interference based is proposed for delay constrained mobile ad hoc network considering the constrains in both delay and interference. In the proposed algorithm, the queuing delay, delay due to contention, delay due to transmission are considered. However in the topology control algorithm that is interference based, the effect of mobility on nodes is investigated, and from the topology, the links that are unstable are removed [15-16].

III. METHODOLOGY

Adhoc networks are infrastructure fewer networks which form its network paths with its self-organisation property. Each sender nodes frame its path to the destination nodes with or without the routing nodes in the network. Each node in the network act as a routing node, when a neighbour node needs to transmit a data to receiver node outside its coverage region. Nodes in the Mobile Adhoc network are mobile, so topology of the network is rapidly variable. A special algorithm is needed to frame a network between the mobile nodes in MANET. Semi graph is used to frame a network topology between the mobile nodes in the Mobile Adhoc Network.

Semi graph is a grouping algorithm which is derived from the concept of graph theory. Semi graph topology provides simplest and low cost paths in the mobile network. The concept graph and semi graph deals with the notations namely edges and vertices, were the edges are the links between two vertices. In other word the vertices are nodes and the edges are links between the nodes. Semi graph is framed to develop maximum edges with limited number of vertices. It develops maximum possible links between the nodes to transfer the data in high speed with less transmission cost. Let consider SG is a semigraph with pairs (X,Y) and X is a non empty set. And the elements in X are represented as vertices. Y is the set of tuples and the element in Y are represented as edges. The constants of variable Y is represented as Y = (E1, E2,..., En) were n >= 2. The semi graph topology should satisfy two conditions they are

- One vertex should be common for any two edges.
- Two edges (A1, A2, ..., An) and (B1, B2, ..., Bm) is equal when m=n thus the A1 and An is represented as end edges and other elements are considered as middle edges.

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A network model is developed using the semi graph technique were pseudo dominant set is framed initially and Steiner tree construction improves the network connectivity among the set. The pseudo dominant set nodes are connected and the redundant nodes at the end edges are omitted. Delay and data transmission complexities are represented as O (nδ) and O (D), were D is represented as network diameter and the δ represents the maximum number of nodes in the network. The implementation of semi graph theory on the Mobile Adhoc network improves the network performance and provides quality of service. Throughput and end to end delay of the network were improved due to the efficient edges and vertices arrangement in semi graph theory which helps the sender node to select the shortest path with less transmission cost.

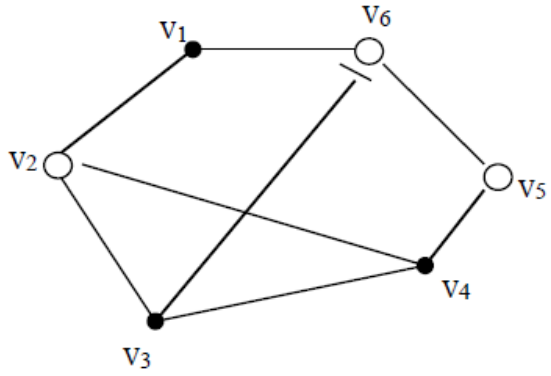

Figure 1: Semi graph model

Figure 1 represents a network model represented using semi graph. The steps in framing a network using semi graph are listed below

Step1: Initialise the node position and frame edges and vertices as

SG = (X, Y) and E = (V1, V2, ... , Vn) be edges, V1 and Vn represent end vertices, and Vi represents middle vertices.

Step2: Determine the adjacent neighbourhood nodes of semigraphs.

Adjacent neighbour set $N_a(U_i)$ of individual node in $U_i \epsilon$ U and $N_a(U_i)$ <= U.

Step3: And then the nodes are sorted in ascending order with adjacent degrees with end vertices connected as semigraph.

SG(U, E) with $|U| = p$ and $|E| = q.$

Step4: The rule was continued until it reaches maximum dominant set.

The performance of the system is analysed by framing a mobile Adhoc network with maximum coverage region of 2000*2000 meters in network simulator tool. Nodes have been placed randomly and semi, the graph is applied to frame a network topology. The configuration of the network was listed in table1.

Table.1 Network Configuration

S.No.	Parameters	Details
1	Node placement	Semi graph
2.	Number of nodes	20
3	Maximum coverage area	2000m * 2000m
4	Traffic interval	0.55 sec
5	Packet size	500bits
6	Initial Energy	1000J
7	Tx Power	0.25mJ
8	Rx Power	0.25mJ
9	Protocol	AODV
10	MAC layer	802.11

IV. RESULTS AND DISCUSSIONS

The MANET network was implemented in NS2 simulation software tool to collect the performance metrics for the proposed semigraph algorithm. The metrics like throughput, end to end delay, packet delivery ratio, packet loss ratio, residual energy was measured. The quality of service of the network is measured by analysing the maximum throughput value and reduced in end to end delay.

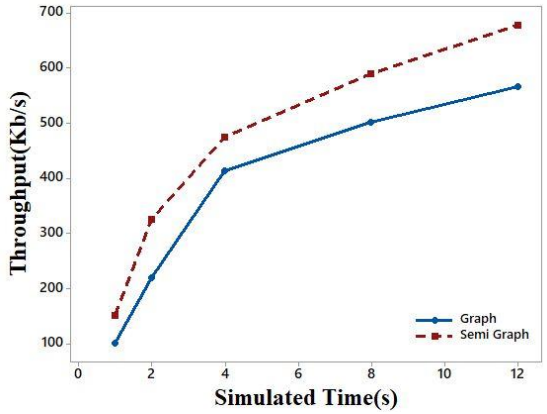

Figure 2: Throughput

The throughput is the measure of maximum data bits transferred at the unit time measured in units second. The proposed semigraph topology is compared with the graph model. The maximum throughput achieved by the semi graph model is 680kb/s, and the graph model is 540kb/s. The throughput of the semigraph model is 140kb/s higher than the graph model. The plot for throughput is shown in figure2.

Packet delivery ratio is the ratio between the number of packets transferred at sender end and the number of packets received at the receiver end at the initial period. The measurement does not represent the number of packets retransmitted. The combination of every successful transmission was measured as throughput and data transmitted and received at the initial time was recorded as packet delivery ratio. The packet delivery ratio increases by time increase because of the identification of the location of the nodes in the network by the protocol. Semigraph model produces the maximum Packet delivery ratio of 84%, and the graph model produces 75%. Figure 3 shows the increase in packet delivery ratio using Graph model and semi graph model in NS2 simulator.

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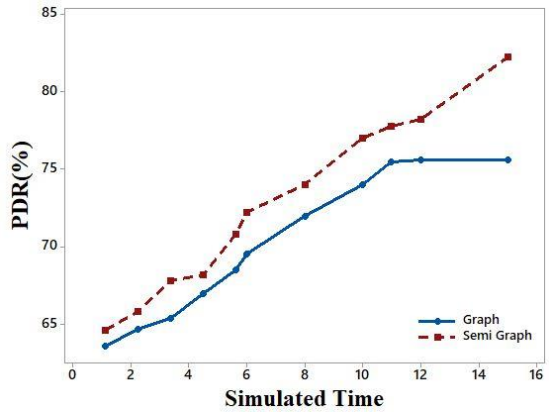

Figure3: Packet delivery ratio

Packet loss ratio is inverse of packet delivery ratio which provides the ratio for the amount of packets dropped during the transmission of the packets from one end to another. The values of throughput, packet delivery ratio and packet loss ratio were compared along with the simulated time. The combination of packet drop and packet delivered promotes the speed of the network which boosts the throughput of the network. Figure 4 represents the packet loss ratio between graph model and the semigraph model. The semigraph model posses >10% loss ratio than the graph model.

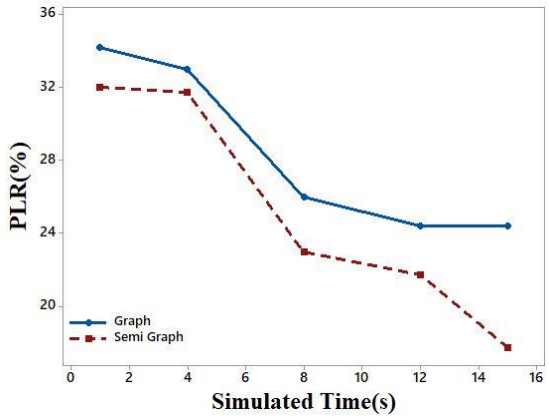

Figure4: Packet loss ratio

Residual energy is the amount of energy consumed by the network during the simulated time. Transmission and retransmission, path identification and idle state of the node in the network will affect the consumption of total power of the network. Cost for transmitting the data between the nodes, i.e., selecting efficient paths for communication also affects the consumption of residual energy in the network. The initial energy of 1000Joules was assigned for the network and the simulated time is set as 16s, and the residual energy consumption was plotted and shown in figure 5. The figure shows that the semigraph model consumes 20% lesser than the graph model in MANET.

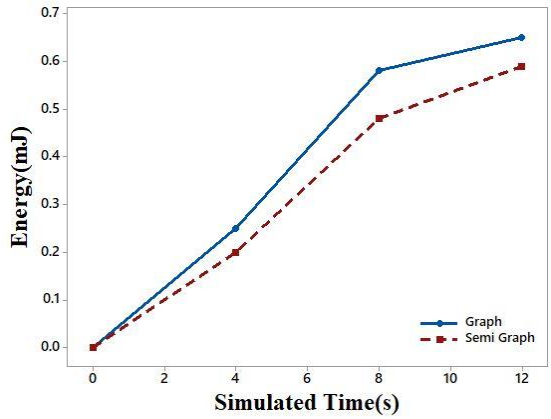

Figure 5: Residual Energy

Time taken by the packets to reach the destination node from the transmitted node at unicast mode is defined as the end to end delay. The delay in the network will affect the performance of the network. The delay increases due to the lack of direct paths between the end nodes or due to the ineffective topology to generate the shortest path or due to packet loss in the network. Figure 6 shows the end to end delay of the simulated network. The end to end delay was plotted against the number of packets transmitted and time taken to receive the destination node in the network.

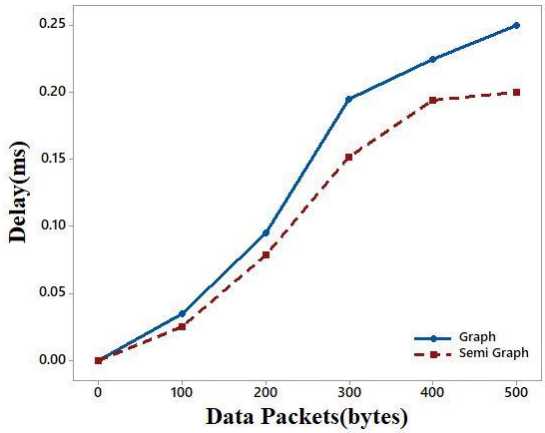

Figure6: End to end delay

The performance metrics of the semigraph model is improved when compared to graph model in MANET. Thus the quality of service is improved by implementing the semigraph model in MANET.

V. CONCLUSION

The Mobile Adhoc network comprises of mobile nodes used to share data between them through the wireless network. Network topology was framed without the centralised framework thus transmitting nodes are responsible for the path generation and path maintenance in the Mobile Adhoc Network. Improving the quality of service is a challenging task in Mobile Adhoc network due to its mobility condition. Semi graph model is developed to improve the performance of the network by generating maximum possible edges which generate more efficient low cast paths between

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the nodes in the network. The performance of the semi graph model is compared with the graph theory model and proved that semi graph provides 80 per cent more efficient topology model than the graph theory.

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