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SECURED OPTIMAL ROUTE MAINTENANCE FOR INTELLIGENT TRANSPORT SYSTEMS

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***Abstract*— VANETs are the networks that rely own vehicles to provide accident avoidance system. Such networks have clear distinctive features such as restricted mobility and high speed of nodes. One of the mainly vital challenges in such a network is reliable routing of data packets among the vehicle users. Ant Colony Optimization is used to search diverse between nodes in the network to avoid link failures. To attain scalability the network has to divide into zones. The use of reactive approach is to discover route within a zone and routes between zones. To reduce broadcasting and overcrowding the local information stored in each zone is used. The algorithm make resourceful network bandwidth is scalable and is strong to link failures. The hybrid algorithm proved to be more efficient in terms of End to End delay and Throughput for the network. In this paper the review of routing protocol which is reactive with Ant colony optimization is shown.**

Keywords*— *VANET, MA-AODV, Multicast routing, Ant colony optimization

I. INTRODUCTION

Vehicular Ad-hoc Network (VANET) is a subclass of an ad hoc network. Vehicles in VANET communicate with close by vehicles or road side units that are mounted in centralized locations such as intersections and parking lots. There are two types of communication: vehicle-to-vehicle (V2V) and vehicle to-infrastructure (V2I). In V2V communication nearby vehicles exchange data by using short range wireless technologies, Wi-Fi and WAVE. Vehicles have a special electronic device that allows them to receive or relay messages. In V2I, vehicles are connected to the nearby road infrastructure via continuous wireless communication through Wi-Fi hotspots or long/wide range wireless technologies for exchanging information relevant to the specific road segment. In this work consider V2V communication. In VANETs, some applications require group communication Therefore, Multicast routing is the most efficient method, overcoming the unicast and broadcast routing The frequent change in the network topology, the high speed of nodes and other features of VANET make the multicast routing a real challenge in vehicular scenarios. Therefore, a proficient good performance in the transmission/reception of multicast packets is required. In V2V, each vehicle (a vehicle in a network) transmits a message to other vehicles using on movement of vehicles although are in an organized fashion, that is, in accordance to signals, several challenges are arised during organizing an efficient routing and links are affected and which need to reorganize connectivity due to the high mobility. Second, because of dynamic network topology, the routing table of each vehicle needs frequent route information which leads lots of communication overhead. This makes destination extremely hard. In general, vehicles use of wireless network as the primary medium to communicate with other vehicles in their radio range using routing protocols. The routing protocols exchange topology related information within the network for an efficient path between vehicles IARP is a family of limited routing protocols. Nodes regularly send information about their inbound neighbors. The hop advertisements is limited to the zone radius IARP is unable to discover the destination node that is out of node's zone, at that time, IERP is called. It is a reactive protocol that enables the discovery of the destination. Rather than focusing on a standard flood search, it exploits the structure of the routing zone to do more intelligent query dissemination [3]. Several works in mobile ad hoc networks have shown that nature inspired (bio inspired or swarm intelligence) algorithms inspired by insects such as ant colony based optimization (ACO), can be successfully applied for developing efficient routing algorithms. These algorithms have many advantages compared to other routing algorithms. For example, they reduce the routing overhead by sharing local information for future routing decisions. They also offer many paths enabling selection of another route in case of link failure on the previously selected path. ACO algorithm is a hybrid routing algorithm that makes effective use of the bandwidth. This algorithm is scalable and robust to avoid link failures. We subdivide the nodes into zones with each vehicle belonging to one or two overlapping zones. We use proactive approach to find a route within a zone and reactive approach to find routes between zones using the local information stored in each zone thereby trying to reduce broadcasting and congestion [2].

II. ISSUES OF ROUTING IN VANETS

Even though VANETs are capable of enabling many novel applications, the design of effective inter vehicular communications remains as a challenge. The nodes in VANETs are themselves formed by vehicles with high mobility. Nodes in VANETs join and leave the network frequently, which results frequent path disruptions. The time varying vehicle density results in a rapid change in topology, which makes preserving a route a difficult task. This in turn, results in low throughput and high routing overhead. The well-known hidden terminal problem [4] affects the performance in VANETs causing low packet reception rate. Interference from the high-rise route building induces problems such as routing loops and forwarding in wrong direction, which increases delay. The issue of temporary network fragmentation and the issue of broadcast storm [5] further complicate the design of routing protocols in VANETs. The routing protocols in VANETs should be capable of establishing the routes dynamically and maintaining the routes during the communication process. They should be capable of discovering alternate routes quickly on-the-fly in the event of losing the path.

Real-time applications and safety related applications demand strict time delay during communication. The design of routing algorithms should identify optimal paths to reduce delay in routing. Multiple routes within a network are required to avoid congestion. The key challenge is to design routing protocols to overcome these problems and to provide communication with minimum delay and with minimum overhead. VANETs allow vehicles to form a self-organizing and self-managing network in a distributed fashion without a centralized authority or a server dictating the communication. It is obvious that the success of VANET applications greatly depend on the routing algorithms applied. Better paradigms are required for information dissemination within the estimated time by designing efficient routing algorithms.

Conventional multicast protocols were designed for wired networks which have a stable network topology. VANETs are very different from these networks and due to that these protocols do not offer good performance for vehicular environments. VANET multicast protocols need to adapt to the characteristics of this kind of networks. They need to take into consideration high node mobility, the high speed of this movement and frequent topology changes and due to that constant delivery path updates. They also need to keep as little state information as possible owing to short route duration. However, VANETs also have benefits for multicast, due to their wireless nature when a node sends a message it is broadcasted to all nodes in range and VANET nodes also do not need to save power consumption, vehicles provide a powerful power supply of long duration, and due to that they can also perform complex computational costs**.**

III. OVERVIEW OF ANT COLONY OPTIMIZATION

Problem solving approaches that take their inspiration from nature (the social behavior of insects and other animals) are termed as Swarm Intelligence (SI). Ant Colony Optimization is one of the significant SI techniques that have been widely applied in providing solution to static and dynamic problems [2]. The behavior of ants have been studied by Goss [7] which shows that ants are able to find out the shortest path from their nest to a food source and also adapt easily to path disruptions that may occur. The Ant Colony Optimization (ACO) is a bio-inspired Meta heuristic procedure. It aims to find suitable solutions in a feasible computational time, rather than the optimal solution in non-feasible time. The inspiring source of ACO is the foraging behavior of real ants. This behaviour enables ants to find the shortest paths between their food sources and their nests. When looking for food ants deposit pheromone on the ground. When they make a decision about a route to go, they choose paths with higher probability that is marked by stronger pheromone concentrations. This behaviour is the basis for the ACO metaheuristic. The ACO metaheuristic can easily adapt to the routing in mobile ad hoc networks because it has the features of: adapting to dynamic topology, evaluation of link transmission quality, path selection solution in feasible time and distributed management control [1]. Fig. 1. Ants behaviour ACO uses stigmergy (i.e. communication through the environment) for interaction among members. Interaction is based on primitive instincts with no supervision. ACO works on the concept of pheromone laying on trails, followed by other ants. Pheromone is a potent form of chemical substance that can be sensed by ants as they travel. It attracts ants and so ants lean to follow trails that have high pheromone concentrations.

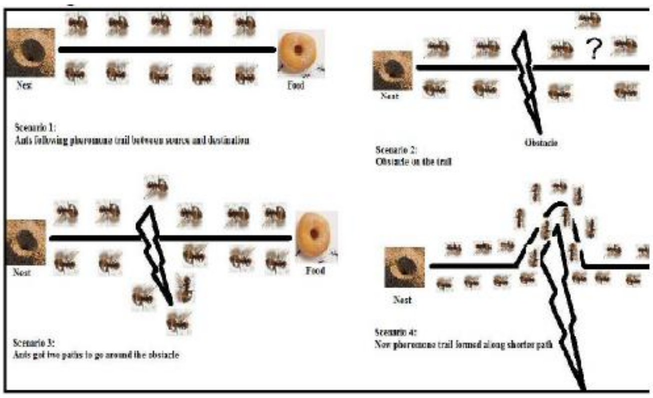

Fig 1: Ants Behavior

This causes an autocatalytic reaction, one that is accelerated by itself. The ability of ants to self organize is based on four principles. They are positive feedback, negative feedback, randomness and multiple communications. • Positive feedback

This is used to improve the good result. When ants move from one node to another, the concentration of the pheromone along that trail increases. This helps other ants to travel in this path. • Negative feedback – This is mainly used to destroy bad solution. It can be done by decay of pheromone concentration with respect to time. The rate of decay is problem definite. Low decay rate encourages the bad result not being destroyed for longer time and higher decay rate destroys good solution early. • Randomness – Path to be taken by ant is completely random hence there is possibility of generation of new solutions. • Multiple interactions – The solution is found by interaction of different agents, so one ant cannot find the food, as the pheromone would decay. Hence more ants can find food faster in food searching process [6].

Zone-based ant colony VANET algorithm

In our algorithm the network is divided into zones. For routing the packets, we follow a proactive approach within the zone and a reactive approach between the zones. The radius length measured in hops determines the size of the zone. A vehicle can exist within two overlapping zones and the zones can vary in size. A vehicle is categorized as interior vehicle, boundary vehicle and exterior vehicle. All the vehicles within a zone having a hop distance of less than the radius are known as interior vehicles. The overlapping vehicles within the zones with the hop distance equal to the radius are known as boundary vehicles and the vehicles with the hop distance greater than the radius are known as exterior vehicles. Figure 2 explains about the vehicles with an example. If the source vehicle is S and the radius of the zone is 2 then vehicles A, D, F are boundary or border vehicles, and vehicles B, C, E are interior vehicles. All other vehicles are exterior vehicles i.e. the vehicles outside the zone

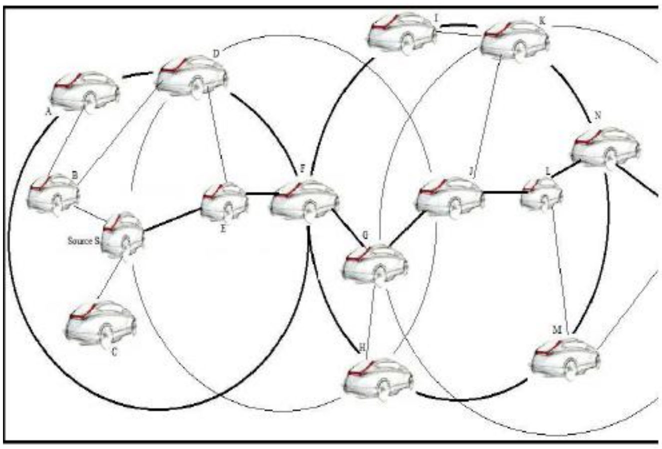

Fig 2: Zone based Ant colony VANET

The two main phases of routing are, route discovery and route maintenance can either happen within the zone or between zones. We have used two routing tables: Intra zone routing table and Inter zone routing table. The Intra zone routing table proactively updates the information within the zone, whereas, the Inter zone routing table tracks the information between the zones, on demand. During route discovery and maintenance, we have used five different types of ants. These are: internal forward ants, external forward ants, backward ants, notification ants, error ants. The data structure of the ant contains Source, Destination, and Sequence number, Type, Hops, Speed, Position and Path. • Source: Source node address is stored in source field. • Destination: This field stores the destination address. This field is left blank for internal forward ant and stores the destination node address for external forward ants. • Sequence Number: Each ant is tagged with a sequence number, stored under sequence number field. • Type: There are five types of ants which are described in the Type field. 0 is internal forward ant, 1 is external forward ant, 2 is backward ant, 3 is notification ant, 4 is error ant. • Hops: It is used to indicate the number of hops between the node and all the nodes within its zone. This field helps to differentiate between a peripheral node and an internal node. For internal forward ant, the zone radius is assigned and for external forward ant, we leave this field blank. • Speed: It is the speed of the vehicle. • Position: This field contains the current position of the vehicle. • Path: Path field represents the sequence of nodes between source and destination.

IV. PROPOSED MODEL

Meta-heuristic optimization: - Ants navigate from nest to food source. Shortest path was discovered via pheromone trails. Each ant moves randomly Pheromone is deposited on path. More pheromone on path increases possibility of path being followed. As Shown in ACO was really a recently proposed Meta heuristic approach for solving hard combinatorial optimization problems. Artificial ants implement a randomized construction heuristic helping to make probabilistic decisions ACO shows great performance with the "ill-structured" problems like network routing.

An Ant will move from node i to node j with probability

$$P_{i,j} = T_{i,j}\,\alpha\left(n_{i,j}, \beta\right)(T_{i,j}\,\alpha)$$

Where $T_{i,j}$ Is the amount of pheromone on edge I,J

A is a Parameter to control the influence of $T_{i,j}$ $n_{i,j}$ is the desirability of edge i,(typically $1/d_{i,j}$)

B is a Parameter to control the influence of $n_{i,j}$ ACO – Pheromone update Amount of Pheromone is updated according to the equation

$T_{i,j}$ = (1-p) $T_{i,j}$ + $\Delta T_{i,j}$ Where $T_{i,j}$ is the amount of pheromone on a given edge i,

P is the rate of pheromone evaporation.

$\Delta T_{i,j}$ is the amount of pheromone deposited, typically given by $\Delta TI,J\ K = 1 / Lk$ if ant k travel on edge i,j 0 Otherwise Where Lk is the cost of the $k\ th$ ant's tour (typically length)

4.1 Multicast Routing protocol

Phase1: Neighbor-Group creation and Multicast Neighbor selection is done through two sub-phases namely: Neighbor-List creation and Multicast group selection. The sub-phases are detailed below:

Neighbor-List creation: The current one-hop neighbor collection is the responsibility of the Neighbor-List creation sub phase. The current one-hop neighbor of a particular node forms the neighbor-list set. The neighbor nodes share this list for selection of distant nodes. As the sparse and partially connected area incorporates in deterministic high mobility, the Neighbor-List is to be updated dynamically. A pro-active approach of sending periodic „hello‟ message is undertaken to encounter the above issue. The hello messages are network layer based; they are sent out by the network layer. It is more convenient to send the "hello‟ messages through the network layer because routing functions can be performed without consideration of the underlying MAC layer technology Multicast group selection. The existing Border node Based Routing (BBR) protocol floods the network without considering the relative distance between the nodes, resulting in an inefficient bandwidth utilization; Considering this issue, the MAV-AODV protocol introduces a threshold τ to classify the current one-hop neighbors which will receive the multicast data packet with respect to the current forwarding(Distant) node. The multicast packet receiving nodes are selected on the basis of transmission time (as transmission time in low node density, light traffic area is directly dependent on physical distance between nodes, other factors are negligible). The „hello‟ messages contain the current timestamp before it has been sent out.

The current forwarding node receives „hello‟ messages from its current one hop neighbors and computes the transmission time and averages two recent successive transmission times of all the one-hop neighbors and then compares with a threshold τ for selection of data packet receiving neighbors. A node k is added to the multicast group of current forwarding node F if the following condition is satisfied. : $TTk(i+1) + TTk(i) \geq 2\tau$, for all k in the one-hop Neighbor-List of F (1) Where, TTk(i) is the computed transmission time for node k at the ith time instant τ is proportional to transmission range of nodes To optimize the utilization of bandwidth and reduce the broadcast overhead, instead of the broadcast behavior of the BBR protocol ,multicasting is adopted in the proposed Distance Node Based Multicast Routing (DBMR).

Phase2: Distant node selection The Distant nodes are selected per multicast event. A Distant node is responsible for storing received multicast data forwarding to appropriate nodes at appropriate time. The Current forwarding(Distant) node multicasts the received data packets only to the nodes those who are the members of the multicast group. It is the responsibility of a particular node to decide whether it is Distant node or not; the current one-hop neighbor information and the received multicast information are used as selection information.

Criteria for the distant node selection procedure

The Distant node/nodes selection criteria in DBMR are similar to the selection of Border node/nodes in the BBR protocol. The selection of a distant node is based on minimum common neighbor approach. The minimum common neighbor approach is undertaken upon the intuitive notion that a Distant node situated at the edge of a transmission range should have a fewer common neighbor or the Distant node/nodes must should have a maximum uncommon neighbor with the current multicast source node as compared to those that are closer to the forwarding node (multicast source node).

Implementation of Distant node selection

The multicast routing protocol involves store-carry and forward approach like the delay tolerant network. The original creator or source of a data packet is by default a distant node. Three tables are needed to be maintained by a particular node namely- Neighbor-List, selection table, and message table. The Neighbor-List contains the one-hop neighbor information. Selection table stores the necessary information for the selection of distant node/nodes. Message table buffers the data packets with the sequence no (packet id). The message table is searched when a new node comes in contact of a particular node to check whether it is a destination of a data packet or not. Reception of duplicate packets is discarded by checking the packet sequence no (packet id). If a new packet arrives a node will perform appropriate action in a specific condition. The condition wise approaches are discussed below:

4.2 Estimated Link Lifetime

The node versatility data given by MAV-AODV convention empowers us to ascertain an imperative portability parameter of the connection: the connection lifetime (tlink). The presence of the connection is reliant on spatial separation between the nodes (Dij), and additionally the greatest scope of correspondence between them (R), i. e., the length of D2(t) _ R2, the nodes i and j are still neighbors. To ascertain (tlink), we must at present think seriously about another vital viewpoint. In the event that two vehicles have fundamentally the same mobility’s (for instance, two vehicles moving in the same heading near one another and with comparable speeds), the join lifetime tends towards interminability. To address this issue, in our work, we express a maximum point of confinement given by characterizing tmaxlifetime. At the point when a guide message touches base at a node, it figures the evaluated connection lifetime. Each of the system hubs makes this figuring and stores this assessment in their separate directing tables, which is continually redesigned by the MAV-AODV convention

4.3 Route Request Message Generation

In MAV-AODV, the course demand messages (Ant-RREQJ) act like ants, used on the guideline of combinatorial advancement issues by the Ant Colony Optimization metaheuristic, investigating the pursuit space (system ways) to discover nourishment (for our situation, any part hub of target multicast bunch) The procedure of sending Ant-RREQ-J to the destination hub is done through show. Every Ant-RREQ-J sent loads the lower lifetime of a course's connection (Lifetime field) and the jump tally to the destination hub (Hop Count field). The estimation of connection lifetime is made utilizing reference point messages what's more, is always redesigned to make it substantial and utilizable.

4.4 Route Reply Message Generation

In the MAV-AODV convention, the Ant-RREP messages (answers to Ant-RREQ-J) act like ants saving pheromone along the course back to the source hub (home), after they have discovered a sustenance source (for our situation, an individual from the multicast tree bunch). Before producing an Ant-RREP, the hub looks at two fields in the Ant-RREQ-J: Lifetime and Hop Count. Based on these qualities, the hub applies comparison 4 to ascertain the pheromone on the course went by the Ant-RREQ-J. The subsequent estimation of comparison 4 is upgraded in the Pheromone field of the Ant-RREP message. Such a message comprises of the Pheromone field, notwithstanding the various fields of the MAODV-RREP., Soon after, the accepting hub sends the Ant-RREP by unicast back to the first sender node demonstrated in the Source-Addr field of the Ant-RREQ-J gotten message. Middle nodes may get more than one Ant-RREP for a given source-destination pair. In the event that the Ant-RREP is legitimate, the MAV-AODV will pick, probabilistically, between the Insect RREP that was at that point put away in the multicast directing table also, the Ant-RREP that has quite recently touched base at the middle of the road hub. The likelihood of picking Ant−RREPolder is given by P(older) and the likelihood of picking Ant−RREPnewer is given by P(newer)

V. IMPLEMENTATION AND EVOLUTION

In order to evaluate the performance of Multicast routing protocol, I have used NS-2 simulator version 2.31. A rectangular field of 1000m×1000m is chosen and simulation time taken is 900 seconds. Simulation setup to generate vehicle mobility trace file for VANET in NS-2 the Vanet SUMO is used. SUMO can generate vehicle mobile topology simulating the operations like vehicle accelerations and decelerations, carto-car and intersection interaction. The MAC protocol used is IEEE 802.11. No. of nodes is 26, and speed of nodes is within the range 0 to 15 m/s. Initially, all the nodes are uniformly placed in the rectangular area with the average distance Lav= 171.4 meters. A connectivity parameter α is defined as the ratio between the radio transmission range (R) and the average distance among neighboring nodes. The performance of multicast routing is analyzed in terms of two performance indices- Packet delivery ratio and Average end-to-end delay as a function of radio range. In Fig.4 it is seen that with the increasing radio range, more precisely with the increase in the connectivity parameter α, the packet delivery ratio increases rapidly, but after reaching about 100m the ratio remains constant then gradually approaches towards 99%.

VI. CONCLUSION

In this paper we comparatively study the performance of reactive routing protocol and ant colony optimization technique. Compare to classical VANET routing scheme the above maintained protocol have a very good performance because of its more efficient techniques, like restricted or directional flooding. The classical technique required more energy and experiencing more delays which will reduce efficiency and performance of routing protocol. To make routing protocol more efficient we are developing it with the help of ant colony optimization (ACO) algorithm so as to compare the performance by considering parameter like Routing overhead, packet delivery ration and maximum delay. So by applying ACO algorithm in routing protocol we can choose an efficient node in the network so to get efficient routing path which naturally increases the performance of protocol. We enhance this study by examine the network against routing attacks. We organize the proposed model by employing security model to design secure routing protocol in VANET.

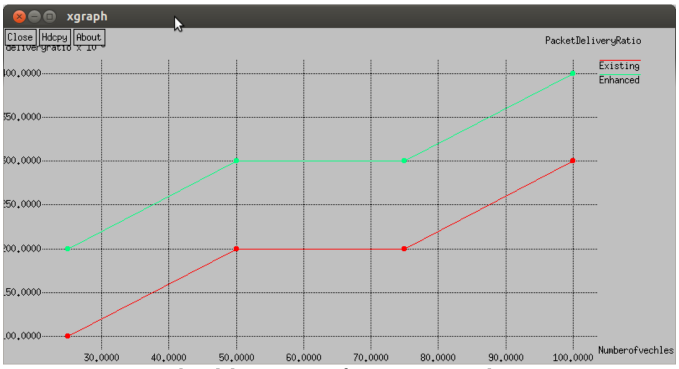

Fig 3: Packet delivery ratio of MA-AODV and MAODV

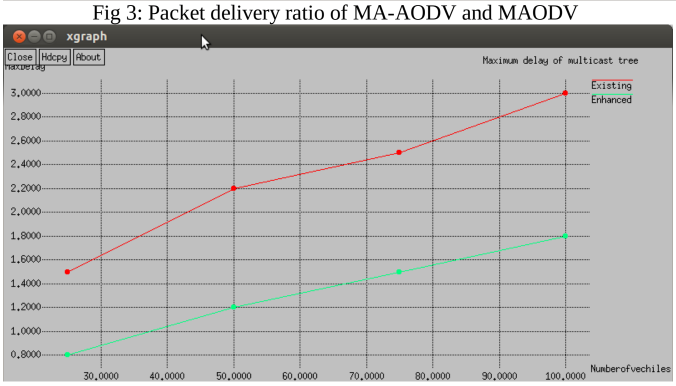

Fig 4: Maximum Delay

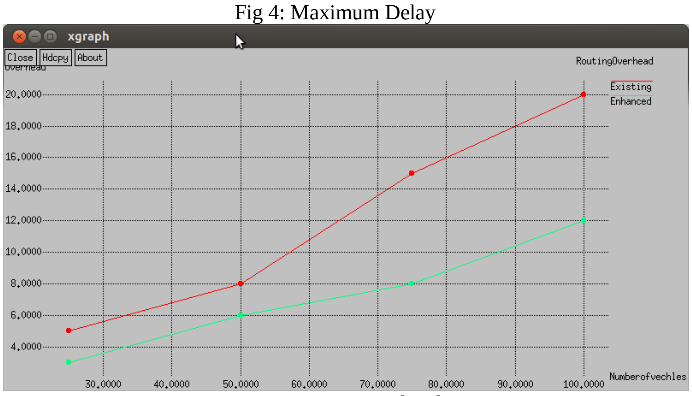

Fig 5: Routing Overhead

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