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Implementation of Routing Protocols of MANETs in VANETs Using Route Analysis

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Abstract— The comparative analysis of routing protocols of MANETs in VANETs under different scenarios. The tests were conducted in MATLAB by varying the vehicles densities. The different parameters used to study these analysises are Packet Delivery Ratio (PDR), Average End-to-End Delay (E2ED), Normalized Routing Overhead (NRO), and Average Link Duration (ALD).

Keywords— Vehicular Ad hoc Networks (VANETs), TDMA-aware Routing Protocol for Multi-hop communications (TRPM), Optimized Link State Routing Protocol (OLSR), Moving Zone Based Routing Protocol (MoZo), Packet Delivery Ratio (PDR).

I. INTRODUCTION

Ad hoc is a Latin word which means "for this reason". A MANET (Mobile Ad Hoc Network) is a versatile specially appointed network configuration which is constantly self-designing, framework less network of mobile computing devices connected without cables.

Every device in the ambit of MANETs is allowed to roam autonomously and by the virtue of this dynamism it will alter its connections to other devices oftentimes all must pass random traffic to their use, and as a result be a router [1]. The essential confrontation in establishing a MANET mechanism is enabling each device to consistently keep up the data required to route traffic legitimately. These networks can operate independently of anyone else or may be associated with the largest Internetwork. It may possess one or more transceivers between different nodes or terminals. This results in a very dynamic and autonomous topology [2].

MANETs are a sort of WANETs that most often has a routing network management condition on top of a link layer of ad hoc network connection [3]. MANETs have a self-shaping, network self-recovery, and peer to peer as opposed to a mesh network has a focal controller (to decide, develop and spread the routing table) [4].

Multi-hop transfers, links back to time immemorial. The development of portable PCs and 802.11 / Wi-Fi distance networking made the MANETs a research centered point from the mid-1990s. Numerous academic papers assessed the protocols and their capabilities, considering fluctuating degrees of mobility within a limited space, typically with all terminals or nodes within a couple of jumps of any other [3].

Various protocols are assessed on the basis of different parameters such as the drop-out rate of data packet, the overhead introduced because of routing protocols, network throughput, the ability to scale, end-to-end data packet delays [5].

A vehicular ad hoc network uses vehicles as locomotive terminal in a Mobile Ad hoc Network (MANET) to establish mobile network. Every participating vehicle end up to a wireless node or router by a VANET, grants cars almost 100-400 meters of one other to connect and, as a result, a wide ranged network is created. If the vehicles went out of the network and signal range, other cars are allowed to join the network [6]. These cars that are connected to each other results in a mobile Internet. The first system that make use of this technology will probably be the fire vehicles and police in order to communicate with one and other for safety and security purposes [7].

In MANETs and VANETs the Topology changes swiftly and unpredictably. The location and position of nodes changes time to time and thus their topologies also changes with passage of time in VANETs [11]. Every node can exchange its information with each and every node in the network, for the reason that the network among them is Ad-hoc Network. Ad hoc network is a type of network in which every node can communicate with every other node without any centralized device. Certain nodes directly communicate with each other in a case if they are close and have direct contact with each other, but not in all cases. If the two nodes are at distance from each other, but within Range of each other, then in this case the Intermediate nodes provide the communication bridge from Source to Destination to deliver the messages.

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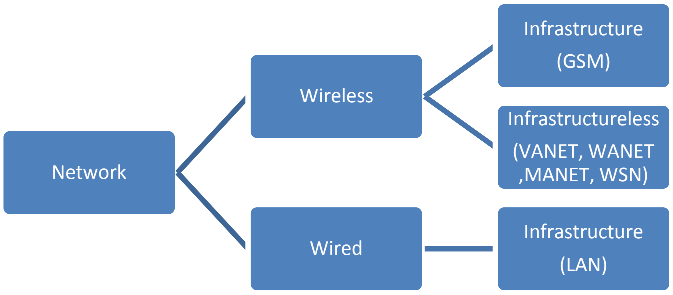

Fig. 1. Types Of Networks

At the point when the transmission of messages is influenced by the loss of connection among source and destination, the recuperation of dropped route is connected here or scan for new conceivable route is done if it is accessible. Route movement, Route Discovery and Route Maintenance are the aspects when the communication connection is breaks amongst nodes. The recuperation of route is done when all node trade the control messages with its neighbors and along these lines the messages surge inside the network. This marvels increases the routing overhead of protocols that we utilized and it impacts the assets of portable nodes which are constrained. At the end of the day the effect of this thing influences the entire existence of our Network and we should limit it for proficient execution of our Routing Protocols.

That time in which two nodes came extremely close to each other and they can both feel the impact of each other so it is called Link duration. When two nodes came in scope of each other up to that degree that they both can detect the presence of each other and the communication may conceivable between them in the event that they both wish so. The nodes are exceedingly dynamic that they move in each direction and every time new topologies are creating, some new nodes came in topology while some leave the topology same time so quickly topologies might be altered.

At the point when two nodes are connected with each other and they have active route then the minimum time of connection between two nodes in case of connected route is known as Path duration. Two nodes enter in scope of each other and one node needs to communicate messages to other node so it will make association or connection first by sending REQUEST message and on this connection they both will send their information. Certainly the ideal opportunity for which Destination node sends REPLY of REQUEST MSG, till teardown of this route and these two nodes have active path on which they both send or get data is known as the path duration. At the point when the connection demolishes among two nodes then they again trade the control packets and connection is again associated between them, so this expands the overhead of our routing protocols.

We can amplify the effectiveness of routes seeking protocols to gather information about link and path duration in an uncommon situation. TRPM ensures the accessibility of first routing path on the grounds that TRPM is Reactive Routing Protocol and it looks for a route when there is need of route for reason for sending data [8]. While on other hand the Optimized Link State Routing (OLSR) is Proactive routing protocol and it chooses the route intermittently on the grounds that the Proactive Routing Protocols have routing table ahead of time and they knew the area of nodes inside the Network and updates this routing table time to time [12].

In Moving zone on the basis of (MoZo) structure comprises a plurality of moving areas, which are formed by vehicles with similar patterns of movement [13]. The captain of the vehicle is selected for each zone and is responsible for managing the information to other vehicles of the user and spread a message [9]. Move construction zone starts logging vehicle on VANET. The vehicle will perform accede to the Protocol Find nearby area or moving form its own zone. The zone formation criteria against Figured based on the similarity of movement of the vehicle. Captain cars each zone keeps moving index object that controls up to date information on all its cars States [10].

The execution and effectiveness of these protocols will be incremented to include the traits and knowledge of path and link duration. Heterogeneity, MAC protocols of energy proficient, Multiple QoS path parameter, Sink mobility are additionally some essential properties and parameters. We pick three routing protocols for our examination where one routing protocol is reactive which are TRPM and two proactive routing protocols which are OLSR and other is MoZo.

II. MATHEMATICAL SECTION

Source (S) sends data to Destination, consequently first source made some selection of next node which also called forwarding nodes who will simply forward its messages and is also called Relay node (R).

$$x = r\alpha \times \pi/1800 \quad (1)$$

And also

$$x = \sqrt{} r2 + D2 - 2rD\cos(\alpha) \quad (2)$$

The solution of Eq. (1) and (2), in order to calculate the distance D between source S and destination D, taking Square on both sides and by arranging variables, we get

$$D2 - 2r\cos(\alpha) D + (r2 - x2) = 0 \quad (3)$$

As in equation (3) we can see that it is the quadratic formula and, if we solve this quadratic equation for distance then we get the value of D which is

$$D = r\cos(\alpha) \pm \sqrt{} (r\cos(\alpha))\ 2 - (r2 - x2) \quad (4)$$

If we derive the Probability Density Function (PDF), then it will be

$$Fd(D) = r2 - x2 - D2/\ 2rD \quad (5)$$

At the point when nodes start to move from their initial location or position than there we have to find the distance D. In order to find the value of distance D here we discuss two cases with respect to the initial positions of nodes. We classify it in two cases on the basis of angles when Source S and forwarding node R are making Acute and Obtuse angles interchangeably.

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Case – 1

We will calculate the Distance Dt1 between Source node and next forwarding node. Here forwarding nodes are making obtuse angle in motion whereas source node are moving with Acute angle as depicted below in fig. 14

Mathematically we derive equation for Distance Dt1when we subtract Y1cos (αA) and add the other value of Y2cos (180 – β0)

$$Dt1 = D - Y1\cos(\alpha A) + Y2\cos(180 - \beta 0) \quad (6)$$

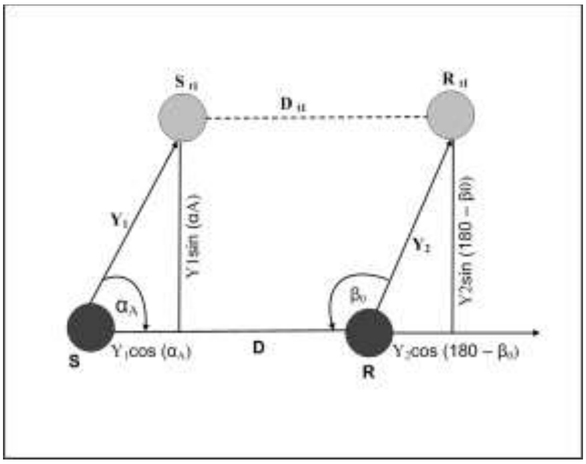

Figure 2: The Link Connectivity Model when Source is moving with acute angle and forwarding nodes with Obtuse angle.

Case – 2

In Case 2 for calculating distance Dt2 we will see that the forwarding nodes move with the angle less than 900 or Acute angle, whereas the Source node will be moving with the Obtuse angle or angle more than 900 as shown in Fig. 2

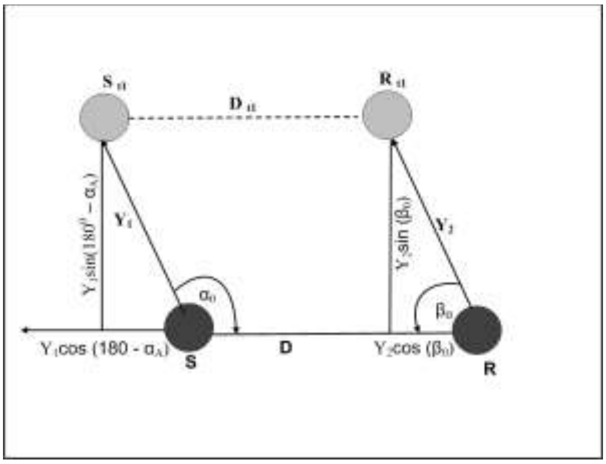

Figure 3: The Link Connectivity Model when Source is moving with Obtuse angle and next forwarding nodes are with acute angle.

The Distance Dt2 will be shown mathematically such as

$$Dt2 = D + Y1\cos(1800 - \alpha 0) + Y2\cos(\beta\alpha) \quad (7)$$

III. LINK DURATION

At a point when the Source node desires to send information to the Destination node or any other node, the Source node (S) directs its message to closest node, which is within Range of Source node in direction of Destination node. The criteria for selection of forwarding node is that the distance of the forwarding node will be Minimum from destination node in Range of Source node.

The distance of a node within Range of other node that communication between them is possible is our Link Duration. Hence we have the two cases of fT (t), which are Probability Density Function PDF of Link Duration. At time when a node enters in Range of another node, it feels the existence of the newly entered node in its range. When they both came in range of each other as a result the communication between them is possible, if they both wish so.

Case 1: When the Velocity of nodes is like so then,

fT (t) = ∫0V max fd (D) fv (vr) d vr (8)

= ∫0V max fd (D) (vr) d vr /π √ 4v2 – vr (9)

Case 2: And the case 2 is about when the velocity of nodes will be alike, hence

fT (t) = ∫0V max fd (D) fv (v1 , v2) d vr (10)

= ∫0V max fd (D) ((-1/v12v22) – (vr v1 v2/ v12 + v22) (11)

And Vmax is the maximum speed of node.

IV. SIMULATIONS AND RESULTS

Here we will see the execution of our three routing protocols in VANETs for PDR. We will get start to discover the Packet Delivery Ratio (PDR) against the parameters of various Scalabilities.

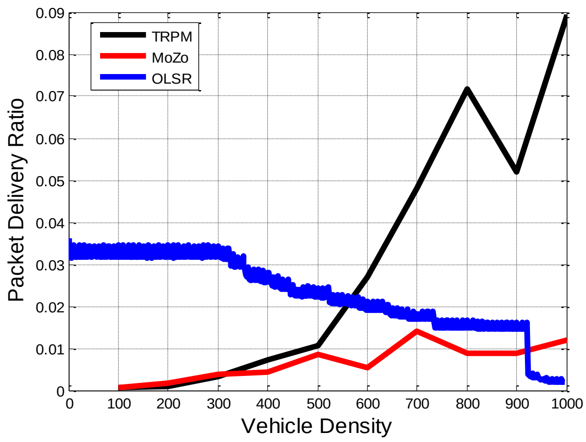

Figure 4: Achieving PDR

In the event that we see the performance of three routing protocols in VANETs for Packet Delivery Ratio (PDR) so it is clear from the Fig 4, that the PDR of TRPM is superior to the other proactive routing protocols (OLSR and MoZo). Its PDR is low in small Number of Nodes yet with expanding of

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Scalability, its Packet Delivery Ratio additionally expanded which make it great than remaining two routing protocols in MANETs. The PDR of MoZo and OLSR is not pleasant at everything but if we compare the performance of MoZo with third one then it shows a little good result for PDR than OLSR but then again not good like TRPM with growing Number of Vehicles or Scalabilities.

The Result of AE2ED in VANETs utilizing our three Routing Protocols which are TRPM, MoZo and OLSR as talked about before. In MANETs, the AE2ED of Reactive Protocol is more prominent in modest Number of Vehicles however diminished with expanding of Scalability yet the End-to-End Delay of Proactive Routing Protocols is efficient. MoZo proving itself better here from both TRPM and OLSR because its E2ED is lower than whatever remains of two other routing protocols. OLSR is giving low End-to-End Delay in low Scalability however increasing its Delay with increasing Number of Nodes in MANETs. Generally the execution of MoZo and OLSR is superior to TRPM in context of AE2ED under MANETs.

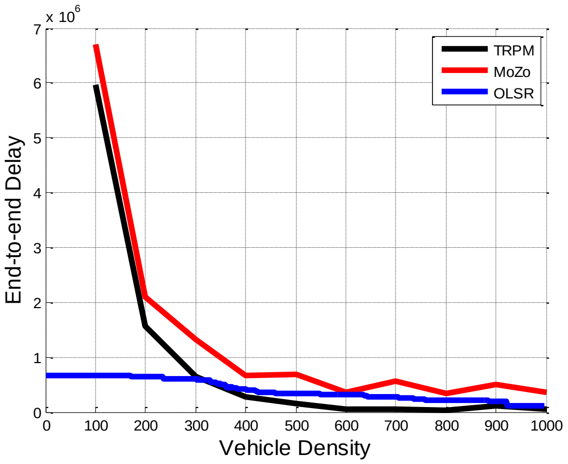

Figure 5: Production of E2ED

In case of VANETs, End-to-End Delay (AE2ED) of (TRPM) is greater than the Proactive Routing Protocols nevertheless when mobility is very high its performance become sensible similar to rest of the two routing protocol. In low mobility, the Delay of TRPM is great however overall role of MoZo and OLSR is same in context of AE2ED in both low and high Mobility in VANETs. Its performance is not affected by low and high mobility like TRPM. Generally in Vehicular Ad-hoc Networks the performance about AE2ED of Proactive Routing Protocols is better in low and high mobilities than Reactive Routing Protocol.

Routing Overhead of TRPM is better in VANETs, in the event that we contrast it with OLSR and MoZO. The Normalized Routing Overhead of Proactive Routing Protocols (OLSR and MoZo) is expanding quickly with expanding of Scalability yet TRPM does not influence like them under various densities. Every one of the protocols demonstrate low NRO when there are 100 vehicles and high routing overhead in low and high number of vehicles in VANETs as can be found in Fig 6.

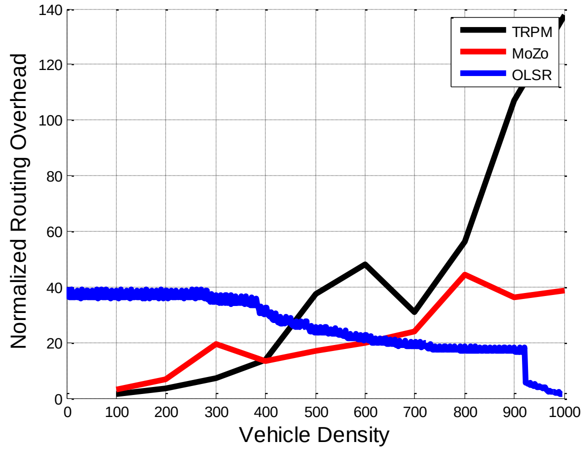

Figure 6: Production of Normalized Routing Overhead

By studying the performance consequences of the three routing protocols in VANETs we can observe that Average Path Duration (APD) of TRPM is high in low Mobility which implies that its NRO is low in less Vehicle Density yet with the element of Density the APD goes descending as appeared. At high Density its outcome is same as OLSR and MoZo giving their Average Path Duration results. However, OLSR and MoZo demonstrate them not very great than TRPM in setting of APD and Normalized Routing Overhead (NRO) in low Density on the grounds that their APD is low in start.

The approaching of two Mobile Nodes within the Range of each other is called ALD. Every mobile node has its own radius of Range; in which it can send its information to other node when other node enters its range. The nodes changes their positions rapidly that's why their topologies also change and these nodes enter or exit from range of each other unpredictably. Hence the entrance of one node within range of other mobile node is ALD.

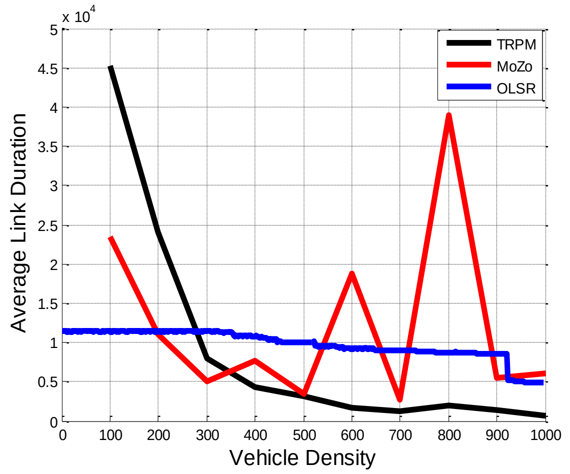

Figure 7: The ALD of protocols under VANETs with varying Scalability

From the above resut in Fig.7 we conclude that ALD of TRPM at low vehicle density is not much pleasant however with increasing vehicle density its ALD improves and we can readily observe from its graph that it is steadily moving down. The TRPM in this particular scenario is 125% more efficient than MoZo and 60% more efficient than OLSR but OLSR performance is better than MoZo by the same margin of 60%. However at low vehicle density the performance of MoZo is better than the two protocols that is MoZo is the ideal protocol in case of low vehicle density but as the vehicle density increases its performance start to undergo a non-uniformity. It can be concluded that at low vehicle density MoZo is the ideal choice while at high vehicle density TRPM is the ideal choice. In the overall scenario TRPM stood first followed by OLSR and then MoZo. While the overall performance of OLSR is satisfactory as the remaining two protocols are perform efficiently at two different scenarios that is at low vehicle density and at high vehicle density.

CONCLUSION

We conclude that TRPM and MoZo are a sort of specialized protocols performing efficient results at different scenarios at some point one protocol performs and show encouraging results at low vehicle density while the other displays impressive results at high vehicle density in the same scenario. The performance of OLSR is satisfactory and often seen that has only displayed satisfactory results at low vehicle density. But here our focal area is high vehicle density where both TRPM and MoZo has displayed good results but if compared the overall performance of TRPM is much better than the other two protocols in all the scenarios. As our detailed study as mentioned in the tables have also displayed that the average performance ratio or percentage of TRPM is highly promising.

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