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Traffic Management on Road using Density Aware Routing

Mr. Gadkari M. Y.[1] , Mr. Sambre N.B.[2],

Abstract— **These Traditionally traffic safety was addressed by traffic awareness and passive safety measures like solid chassis, seat belts, air bags etc. With the recent breakthroughs in the domain of mobile ad hoc networks, the concept of vehicular ad hoc networks (VANET) was realised. Safety messaging is the most important aspect of VANETs, where the passive safety (accident readiness) in vehicles was reinforced with the idea of active safety (accident prevention)[5]. In safety messaging vehicles will message each other over wireless media, updating each other on traffic conditions and hazards. Security is an important aspect of safety messaging, that aims to prevent participants spreading wrong information in the network that are likely to cause mishaps. In this paper we propose Traffic management with Density Aware Routing (TMDAR) which is based on realistic road topology. TMDAR exploits the available road hierarchy information to transfer data from source to destination.**

Index Terms— ***TMDAR,VANET,RRFD, hierarchy, local maximum***

I. Introduction

VANET (Vehicular Ad-hoc Network) is a new technology which has taken enormous attention in the recent years. Vehicular ad hoc network is formed by cars which are called nodes; allow them to communicate with one another without using any fixed road side unit. It has some unique characteristics which make it different from other ad hoc network as well as difficult to define any exact mobility model and routing protocols because of their high mobility and changing mobility pattern. Today, more and more research is dedicated to VANETs.VANETs allow inter-vehicular communication V2V to provide safety and comfort to both drivers and passengers. This has influenced most of the automobile manufactures to take part in the development of this technology[4].

VANETs operate by gathering existing traffic scenarios. Some of the services provided by VANETs such as warning message dissemination reduce the number of road accidents and traffic jams caused by traffic fatalities . Apart from these applications, this technology can also be used to provide various vehicular services such as transparent connection to Internet and intranet, telecommunication services, intracar communication, infostations[3].

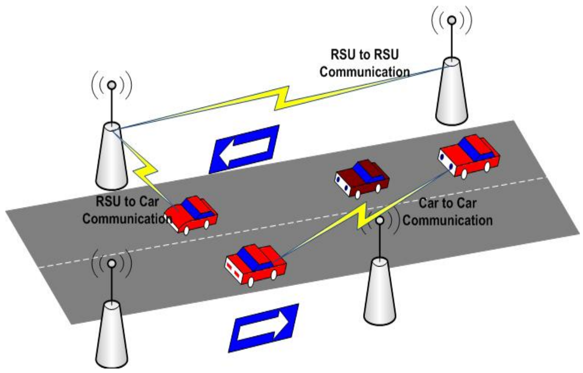


Figure 1: VANET communication

Analysis of traditional routing protocols for mobile adhoc networks (MANETs) demonstrated that their performance is poor in VANETs . The main problem with these protocols in VANETs environments is their route instability. The traditional node-centric view of the routes (i.e., an established route is a fixed succession of nodes between the source and destination) leads to frequent broken routes in the presence of VANETs' high mobility.The available algorithms for VANET are AODV,DSDV,DSR,GPSR etc[7].

AODV: Ad hoc On-Demand Distance Vector (AODV) Routing is a routing protocol for mobile ad hoc networks (MANETs) and other wireless ad-hoc networks. It is a reactive routing protocol, meaning that it establishes a route to a destination only on demand. AODV is, as the name indicates, a distance-vector routing protocol.. AODV is capable of both unicast and multicast routing[7].

DSDV: Destination-Sequenced Distance-Vector Routing (DSDV) is a table-driven routing scheme for ad hoc mobile networks based on the Bellman-Ford algorithm. Each entry in the routing table contains a sequence number, the sequence numbers are generally even if a link is present; else, an odd number is used. The number is generated by the destination, and the emitter needs to send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates more frequently[7].

DSR:Dynamic Source Routing (DSR) is a routing protocol for wireless mesh networks. It is similar to AODV in that it forms a route on-demand when a transmitting computer requests one. However, it uses source routing instead of relying on the routing table at each intermediate device[8].

GPSR:Greedy Perimeter Stateless Routing, GPSR, is a responsive and efficient routing protocol for mobile, wireless networks. Unlike established routing algorithms before it, which use graph-theoretic notions of shortest paths and transitive reachability to find routes, GPSR exploits the correspondence between geographic position and connectivity in a wireless network, by using the positions of nodes to make packet forwarding decisions. GPSR uses greedy forwarding to forward packets to nodes that are always progressively closer to the destination. In regions of the network where such a greedy path does not exist (i.e., the only path requires that one move temporarily farther away from the destination), GPSR recovers by forwarding in perimeter mode, in which a packet traverses successively closer faces of a planar subgraph of the full radio network connectivity graph, until reaching a node closer to the destination, where greedy forwarding resumes[6].

II. PROPOSED METHOLOGY :TMDAR

TMDAR protocol introduced in this paper can be clustered into four important parts a) Route discovery using road hierarchy, b) Greedy Forwarding, c) Route selection using density information , d) Route maintenance using periodic update.

A) Route discovery using road hierarchy:

TMDAR uses hierarchies specified to classify the roads of a city. The hierarchical view of the road topology is shown below in Figure 2.

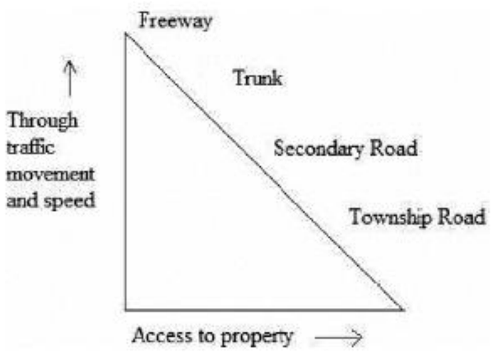


Figure 2: Road hierarchy

Figure 2 shows the road hierarchy used in India. At the bottom of the figure is the city street road which is also known as street level hierarchy. This street level hierarchy is more flexible since it extends to most of the places that the next level hierarchy cannot reach directly. The structure of each hierarchy is shown in Figure 3.

In our contribution, for the route discovery process, TMDAR calculates the shortest path in each hierarchy. The model used to calculate the shortest path is a spatial model G (E, V), where V is a set of vertices representing road intersections (called waypoints) and E is a set of edges representing the road segments between two road intersections. Each waypoint W= {ID, x, y} consists of its ID and its geographical position (x, y). Each edge is represented by two vertices [1].

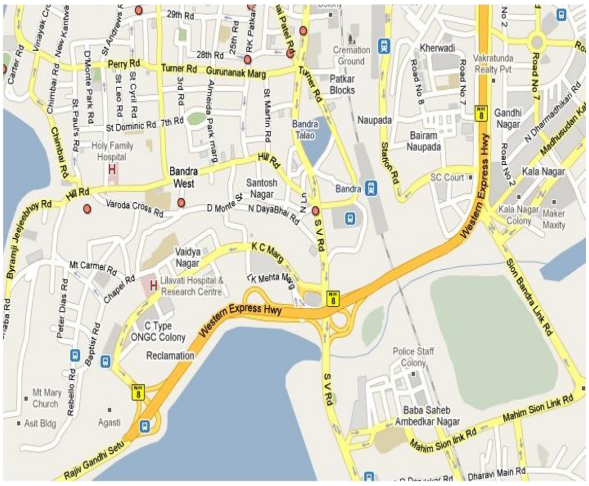


Figure 3: Road map of Mumbai city

e= {WI, W2}. Edges are also referred to as road links. The shortest path is calculated by the use of the Dijkstra algorithm. The shortest path is calculated by taking only the distance into consideration. In order to obtain the real time traffic density in the calculated routes test packets are sent. These test packets are sent through the calculated shortest path in unicast manner. The test packet gathers density count information at every intermediate packet hop until the destination. Since two routes are maintained, in case of a local maximum condition in one route packet transfer can be continued along the other route[1].

B. Greedy Forwarding

The test packets, containing the shortest path, are forwarded greedily to the destination. a packet is guided along a particular route from source to destination considering intermediate waypoint as temporary destinations[6]. Each intermediate node checks the number of neighbors in its neighbor list and specifies the number of neighbors which are ahead of it. The intermediate node also checks its distance from the temporary destination; if it is less than its radio range then it sets the next waypoint in the source route as the temporary destination contained in the test packet. If there is no waypoint left in the shortest path then the intermediate node sets the destination position as the final destination. This forwarding mechanism is used for all packet types (Test, data, RRFD). But only the test packet contains density information[1].

C. Route selection using density information

When the destination receives the test packet it checks the density count added by each intermediate node. If the destination receives a test packet from one route earlier than the other, and if the density count is less than threshold at any intermediate node, the destination waits for the test packet from the other route. The threshold value is defined as the average number of nodes required, in order to keep a route between source and destination connected. The destination chooses the route which is best connected and which takes minimum time to the destination. The destination replies to the source with a Route Reply from Destination packet (RRFD) via the selected route. Once the source receives the RRFD packet, the data packet is sent via the route traversed by the RRFD packet.

D. Route maintenance using periodic update

Route maintenance is one of the most important aspect for any source routing-based protocol. Since this paper includes mobile nodes, there is a need for good synchronization in terms of current location between source and destination. To incorporate this, the source sends its current location in the test packet sent to the destination and the destination sends its current location to the source through the RRFD packet. The route discovery and selection process is done before the data packets are initially sent. Once the source starts the flow of data packets, after every timeout period, route discovery and selection are done as the data packets. The timeout period can vary depending on how often the route has to be maintained.

If we consider higher hierarchy and lower hierarchy paths, if local maximum condition occurs in the lower hierarchy, test packet sent along this route may not reach the destination. In such a case, the test packet sent via a higher hierarchy reaches the destination and the RRFD is sent along higher hierarchy. The source always sends the data flow in the path in which RRFD was received[2]. Generally the higher hierarchy route is always available, because density on the higher hierarchy road is always greater than on the lower hierarchy road[1].

III. Implementation

Simulation setup:

TMDAR is implemented in the NS2 network simulator. The version used is 2.34 on the Linux platform. To evaluate the performance of TMDAR, the AODV protocol is used. First traffic pattern is generated using vanetmobisim then the generated file is used in NS2 as shown in figure 4 .The simulation parameters are shown in Table 1.

Parameters	**Values**
Total simulation time	100s
Total no of vehicals	100
Simulation area	1100 m x1100 m
Movement speed	20km/hr -60km/hr
Traffic type	cbr
Transmission range	100m

Table 1: simulation parameters.

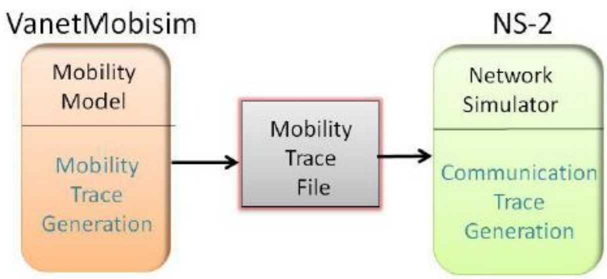


Figure 4: simulation architecture.

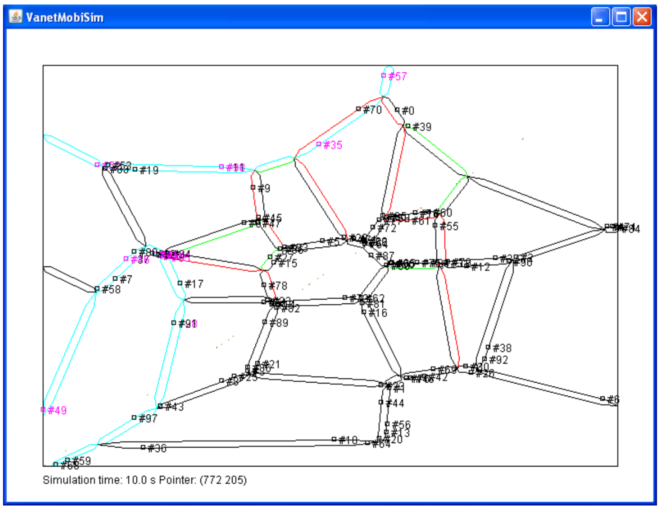
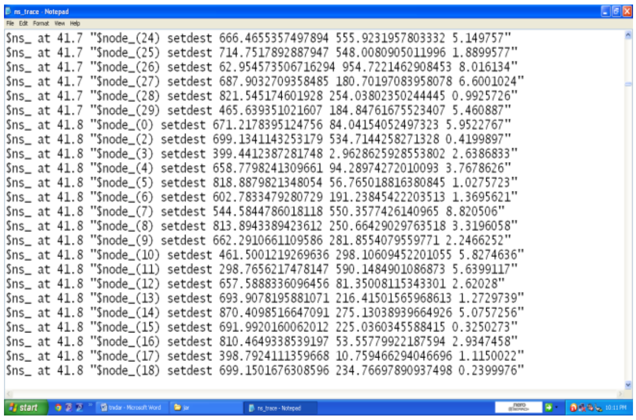


Figure 5: VANET implementation using vanetmobisim.



```
$ns_ at 41.7 "$node_(24) setdest 666.4655357497894 555.9231957803332 5.149757"
$ns_ at 41.7 "$node_(25) setdest 714.7517892887947 548.0080905011996 1.8899577"
$ns_ at 41.7 "$node_(26) setdest 62.954573506716294 954.7221462908453 8.016134"
$ns_ at 41.7 "$node_(27) setdest 687.9032709358485 180.70197083958078 6.6001024"
$ns_ at 41.7 "$node_(28) setdest 821.545174601928 254.03802350244445 0.9925726"
$ns_ at 41.7 "$node_(29) setdest 465.639351021607 184.8476167552340 7 5.460887"
$ns_ at 41.8 "$node_(0) setdest 671.2178395124756 84.04154052497323 5.9522767"
$ns_ at 41.8 "$node_(2) setdest 699.134114325317 9 534.7144258271328 0.4199897"
$ns_ at 41.8 "$node_(3) setdest 399.4412387281748 2.9628625928553802 2.6386833"
$ns_ at 41.8 "$node_(4) setdest 658.7798241309661 94.28974272010093 3.7678626"
$ns_ at 41.8 "$node_(5) setdest 818.8879821348054 56.765018816380845 1.0275723"
$ns_ at 41.8 "$node_(6) setdest 602.7833479280729 191.2384542220351 3 1.3695621"
$ns_ at 41.8 "$node_(7) setdest 544.5844786018118 550.3577426140965 8.820506"
$ns_ at 41.8 "$node_(8) setdest 813.8943389423612 250.66429029763518 3.3196058"
$ns_ at 41.8 "$node_(9) setdest 662.2910661109586 281.8554079559771 2.2466252"
$ns_ at 41.8 "$node_(10) setdest 461.5001219269636 298.1060945220105 5 5.8274636"
$ns_ at 41.8 "$node_(11) setdest 298.7656217478147 590.148490108687 3 5.6399117"
$ns_ at 41.8 "$node_(12) setdest 657.5888336096456 81.35008115343301 2.62028"
$ns_ at 41.8 "$node_(13) setdest 693.9078195881071 216.41501565968613 1.2729739"
$ns_ at 41.8 "$node_(14) setdest 870.4098516647091 275.13038939664926 5.0757256"
$ns_ at 41.8 "$node_(15) setdest 691.9920160062012 225.036034558841 5 0.3250273"
$ns_ at 41.8 "$node_(16) setdest 810.4649338539197 53.55779922187594 2.9347458"
$ns_ at 41.8 "$node_(17) setdest 398.7924111359668 10.759466294046696 1.1150022"
$ns_ at 41.8 "$node_(18) setdest 699.1501676308596 234.76697890937498 0.2399976"
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Figure 6: traffic pattern generated using vanetmobisim.

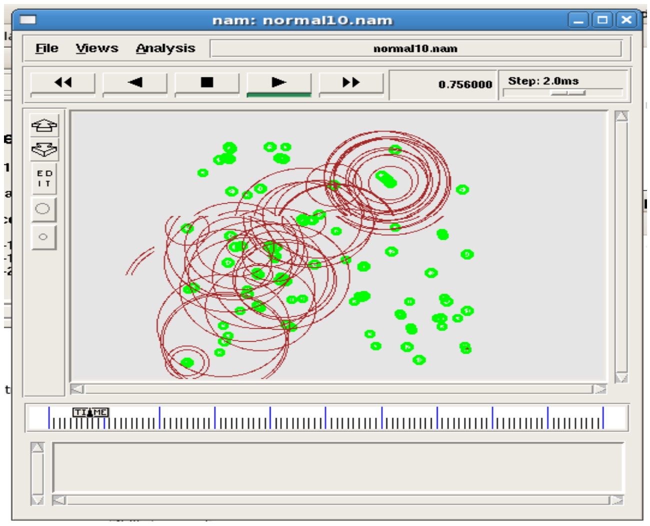

Figure 7: ns2 simulation

In order to evaluate the performance of the developed protocol, we tested for the following routing metrics:

a)Average end-to-end delay: This is the average delay between the data packet is sent and the time when the packet is delivered to its destination.

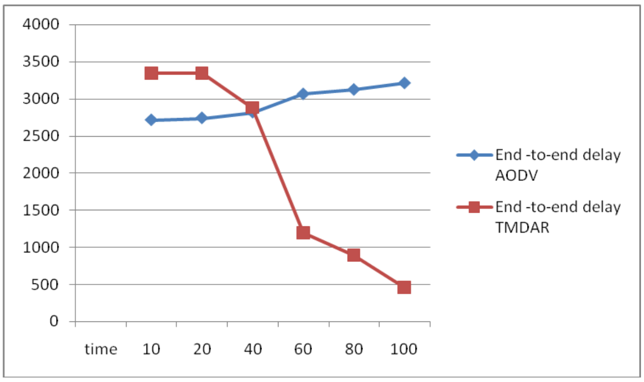

Figure 8: Average delay comparision using xgraph

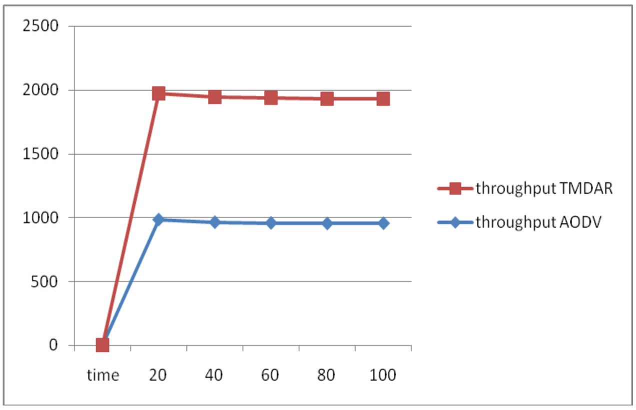

Figure 9: Throughput comparision using xgraph

As observed in figure 8and figure 9, TMDAR performs well under high mobility of VANET compared to AODV.

IV. Conclusion

As the available algorithms in ns2 like AODV having limited capability to transmit packets efficiently to the destination.With the help of simulation TMDAR is working fine in dense as well as sparse network.The TMDAR algorithm having end-to-end delay as well as average throughput comparatively better than AODV.

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Authors Biography:

Mushtak Y. Gadkari , Lecturer in information technology ,in Rajendra mane college of engineering and technology,Ambav ,Ratnagiri having 6 years of experience in teaching. Persuing ME in Electronics & Telecommunication. Research area is VANET and Wireless network

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Nitin B. Sambre ,Associate professor in KIT, Kolhapur,having 23 years of teaching experience . his area of interest is networking and image processing.