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Improved Routing Decision Protocol for Vehicular Ad-Hoc Networks

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Abstract— The aim of this work is to develop a VANET-Simulation scenario for supporting various VANET specific applications mobile distributed applications ranging from traffic alert dissemination and dynamic route planning to context-aware advertisement and file sharing. The main concern is whether the performance of VANET routing protocols can satisfy the throughput and delay requirements of such applications. Considering the large number of nodes that participate in these networks and their high mobility, The problem still exist about the feasibility of applications that use end-to-end multi-hop communication in Intersection Routing on City Roads when they are executed in Real-Time Vehicular Traffic. Simulation was done using urban city maps settings and they will evaluate performance best in terms of average delivery rate.

Key words: VANET, Ad-Hoc Network, Vehicular Routing, Simulation Model

I. Introduction

Wireless communication technologies have now greatly impact our daily lives. From indoor wireless LANs to outdoor cellular mobile networks, wireless technologies have benefited billions of users around the globe. A vehicular ad hoc network (VANET) uses moving vehicles for example cars as mobile nodes in a MANET to create a mobile network.[2] A VANET turns every participating car into a wireless router or node, allowing vehicles approximately 100 to 300 meters of each other to connect and, in turn, create a network with a wide range. As vehicles fall out of the signal range and drop out of the network, other vehicles can join in the network, connecting vehicles to one another so that a mobile Internet is created. It is estimated that the first systems that will integrate this technology are police and fire vehicles to communicate with each other for safety purposes. Automotive companies like General Motors, Toyota, Nissan, DaimlerChrysler, BMW and Ford promote the Development of VANETS

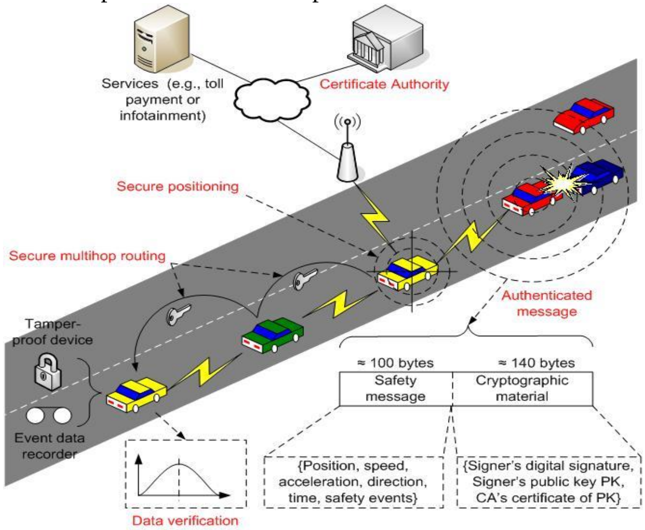

Fig. 1: Schematic Representation of a Vehicular Ad-hoc Network

The era of vehicular ad hoc networks (VANETs) is now evolving, gaining attention and momentum. Researchers and developers have built various VANET algorithms to allow the study and evaluation of various media access, routing, and emergency warning protocols. VANET is fundamentally different from MANETs (mobile ad hoc networks) simulation because in VANETs, vehicular environment imposes new issues and requirements, such as constrained road topology ,multi-path fading and roadside obstacles, traffic flow models, trip models, varying vehicular speed and mobility, traffic lights, traffic congestion, drivers behavior, and many more.

II. Categories of VANETs

Vehicular ad hoc networks (VANETs) represent a rapidly emerging research field and are considered essential for cooperative driving among vehicles on the road. VANETs are characterized by:

- Trajectory-based movements with prediction locations and time-varying topology
- Varying number of vehicles with independent or correlated speeds,
- Fast time-varying channel (e.g., signal transmissions can be blocked by buildings),
- Lane-constrained mobility patterns (e.g., frequent topology partitioning due to high mobility), and finally,
- Reduced power consumption requirements.

So far, the development of VANETs is backed by strong economical interests since vehicle- to-vehicle (V2V) communication allows the sharing of wireless channels for collision avoidance (improving traffic safety), improved route planning, and better control of traffic congestion

Deploying and testing VANETs involves high cost and intensive labor. Hence, simulation is a useful alternative prior to actual implementation. Simulations of VANET often involve large and heterogeneous scenarios. Compared to MANETs, when we simulate VANETs, we must account for some specific characteristics found in a vehicular environment. Based on previous studies of mobility behavior of mobile users, existing models try to closely represent the movement patterns of users.

Moreover, it is well known that mobility models can significantly affect simulation results. For results to be useful, it is important that the simulated model is as close to reality as possible. For MANETs, the random way point model (RWP) is by far the most popular mobility model [6], but in a vehicular network, nodes (vehicles) can only move along streets, prompting the need for a road model. Another important aspect in VANETs is that nodes do not move independently of each other; they move according to well-established vehicular traffic models, so the results for MANETs may not be directly applicable. Moreover, the speed of these nodes are different (in MANETs, nodes' speed ranges from 0 to 5m/s, while in VANETs speed ranges from 0 to 40m/s).

III. ROUTING IN VEHICULAR AD HOC NETWORKS

Vehicular ad hoc networks exhibit different characteristics from classical ad hoc networks. First, the mobility of vehicles is restricted by the road layout, other vehicles' movements and traffic rules. It is also affected by external factors like weather conditions or the timeframe under consideration. In addition, different scenarios such as cities or highways lead to distinct distributions of vehicles. The most salient feature derived from vehicular mobility patterns, is the fact that vehicles tend to move in groups forming clusters. Thus, the network becomes highly partitioned and an end-to-end path between source and destination might not exist at the time of sending a data message [7]. All these factors make traditional ad hoc routing not to be a very appropriate solution for vehicular settings. Thus, specific protocols have been proposed accordingly.

Because of the great number of vehicles which may participate on a VANET, routing protocols need to be localized to ensure their scalability. That is, vehicles make routing decisions solely based on information locally available in their close vicinity. Therefore, exchanging information with neighboring vehicles via beacon messages is a fundamental part of routing protocols in the literature.

Usually, vehicles can obtain position information from systems like GPS and Galileo. Hence, many protocol designers have employed geographic routing as the basis for VANET-specific solutions. By using greedy heuristics, the protocols choose as next hop the neighbor which provides greater advance towards the destination's position (i.e., the one which is closer to the destination). However, there are known problems associated to geographic routing protocols in VANET scenarios. Several authors have adapted traditional geographic routing to the singularities of vehicular scenarios. GPCR and CAR are examples of these approaches.

Other protocols try to improve the performance obtained with geographic routing by means of using digital maps. In this way, the map provides information about topology of streets. This is employed by the source node to compute a list of junctions which the data message must traverse to get to the destination. In order to reach each junction, the protocols apply geographic routing along each street. GSR and A-STAR are examples of geographic-based VANET routing protocols that employ map information.

IV. VANET ROUTING PROTOCOLS

VANET routing protocols can be categorized in to two major categories:

- Topology based routing protocols and,
- Geographic (position based) routing protocols.

In topology based routing protocols each node is expected to know the entire network topology. In Geographic or position based routing protocols the decision on routing is based on the position of the sender, position of the destination and position of the senders one hop neighbors using GPS. It is assumed that each node knows its position and the position of the destination. The position of its one hop neighbors is obtained from periodically exchanged beacons. In geographic routing the messages can be forwarded to destination without knowing the topology and without prior route discovery. This section briefly describes some prominent geographic routing protocols.

V. REQUIREMENTS OF VANET APPLICATIONS

Future VANET applications will have four fundamental demands: scalability, availability, context-awareness, and security and privacy.

A. Scalability:

Because of the number of vehicles that could be incorporated into vehicular networks, VANET may become the largest ad hoc network in history. Undoubtedly, scalability will be a critical factor. The advantages of hybrid architecture, together with in-network aggregation techniques and P2P technologies, make information exchange more scalable.

B. Availability:

Due to the real-time interaction between vehicular networks and the physical world, availability is an important factor in system design. This may have a major impact on the safety and efficiency of future highway systems. The architecture should be robust enough to withstand unexpected system failures or deliberate attacks.

C. Context-Awareness:

As a cyber-physical system, VANET collects information from the physical world and may conversely impact the physical world. On the one hand, protocols should be adaptable to real-time environmental changes, including vehicle density and movement, traffic flow, and road topology changes. On the other hand, protocol designers should also consider the possible consequences the protocol may have on the physical world.

D. Security and Privacy:

There is a recent trend of making vehicular on-board computer systems inter-connectable to other systems. The Ford Sync, for example, connects the vehicle's entertainment system to the driver's cell phone via blue-tooth technology. In the future, vehicular on-board computers could even be open to software developers. These trends may have serious implications for security and privacy due to the cyber physical nature of VANET. Governments and consumers will have very high expectations of VANET

VI. PRESENT WORK

Vehicular ad hoc networks (VANETs) are expected to support a large spectrum of mobile distributed applications that range from traffic alert dissemination and dynamic route planning to context-aware advertisement and file sharing. Considering the large number of nodes that participate in these networks and their high mobility, The problem still exist about the feasibility of applications that use end-to-end multi-hop communication in Intersection Routing on City Roads when they are executed in Real-Time Vehicular Traffic[10].

The main concern is whether the performance of VANET routing protocols can satisfy the throughput and delay requirements of such applications. Our work focuses on VANET routing in city-based scenarios. Analyses of traditional routing protocols for mobile ad hoc networks (MANETs) demonstrated about performance in VANETs. The main problem with these protocols, e.g., ad hoc on-demand distance vector (AODV) and dynamic source routing (DSR), in VANET 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 the destination) leads to frequent broken routes in the presence of VANETs' high mobility, Consequently, many packets are dropped, and the overhead due to route repairs or failure notifications significantly increases, leading to low delivery ratios and high transmission delays. We will design and implement an improved model for Intersection Based VANET Routing on City Roads Using Real-Time Vehicular Traffic and compared them with protocols representative of mobile ad hoc networks and VANETs. Simulation will be done using urban city maps settings and we will evaluate performance best in terms of average delivery rate.

VII. VANET ROUTING ALGORITHM

Dijkstra's algorithm works by visiting vertices in the graph starting with the object's starting point. It then repeatedly examines the closest not-yet-examined vertex, adding its vertices to the set of vertices to be examined. It expands outwards from the starting point until it reaches the goal. Dijkstra's algorithm is guaranteed to find a shortest path from the starting point to the goal, as long as none of the edges have a negative cost.

The Greedy Best-First-Search algorithm works in a similar way, except that it has some estimate (called a heuristic) of how far from the goal any vertex is. Instead of selecting the vertex closest to the starting point, it selects the vertex closest to the goal. Greedy Best-First-Search is not guaranteed to find a shortest path. However, it runs much quicker than Dijkstra's algorithm because it uses the heuristic function to guide its way towards the goal very quickly.

A. Wouldn't it be nice to combine the best of both?

Dijkstra's and Greedy-Best-First algorithms are combined to give A* algorithm .A* is admissible and considers fewer nodes than any other admissible search algorithm with the same heuristic. This is because A* uses an "optimistic" estimate of the cost of a path through every node that it considers—optimistic in that the true cost of a path through that node to the goal will be at least as great as the estimate. But, critically, as far as A* "knows", that optimistic estimate might be achievable.

B. Here is the main idea of the proof:

When A^* terminates its search, it has found a path whose actual cost is lower than the estimated cost of any path through any open node. But since those estimates are optimistic, A^* can safely ignore those nodes. In other words, A^* will never overlook the possibility of a lower-cost path and so is admissible**.**

Below is the classic representation of the A^* algorithm.

$$f'(n) = g(n) + h'(n)$$

g(n) is the total distance it has taken to get from the starting position to the current location.

h'(n) is the estimated distance from the current position to the goal destination/state. A heuristic function is used to create this estimate on how far away it will take to reach the goal state.

f'(n) is the sum of g(n) and h'(n). This is the current estimated shortest path. f(n) is the true shortest path which is not discovered until the A* algorithm is finished.

VIII. RESULTS AND ANALYSIS

We have developed a VANET-Simulation scenario for supporting various VANET specific applications. The large spectrum of mobile distributed applications range from traffic alert dissemination and dynamic route planning to context-aware advertisement and file sharing. Generation of Real time Vehicular Traffic that can be used to test the VANET, the system will use the Micro-simulation of each vehicle in the scenario.

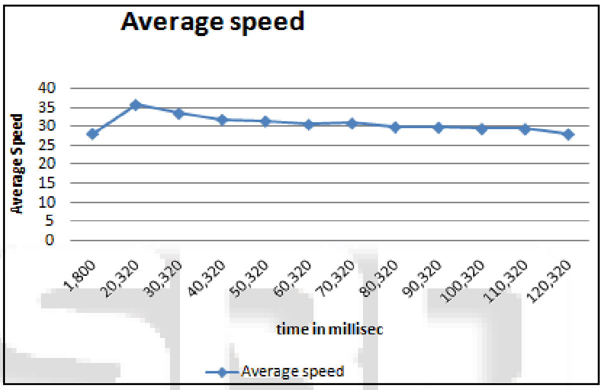

Fig. 1: Average speed vs. time

Each vehicle will be simulated individually and Enabled random choices by the vehicle in the Micro-simulation of each vehicle hence vehicle can take decisions on its own making road traffic is as realistic as possible. In this research one of our aim was to maintain the average speed and we succeeded in this work. The graph below show that we maintained average speed of 25.5. The time complexity to find shortest path is also reduced as compare to other algorithms. But we also found that number of messages drop increases with time. As the time increases the number of messages failed also increases which should not happen, this is also one of the limitation of our work. We have been successful in achieving the following objectives that were set for this research work.

A. Performance Analysis

The aim of this work is to develop a VANET-Simulation scenario for supporting various VANET specific applications mobile distributed applications ranging from traffic alert dissemination and dynamic route planning to context-aware advertisement and file sharing. The main concern is whether the performance of VANET routing protocols can satisfy the throughput and delay requirements of such applications. Following graphs show the results of our work. Fig 1.2 plots the number of active vehicles vs. time. It shows that number of vehicles participate in vanet scenario remain constant. Fig 1.1 plots the average speed vs. time. It shows that Average speed f vehicle will remain constant. It will not degrade with time. Fig 1.3 plots messages created and messages dropped vs. time. It shows that number of messages dropped increase with time.

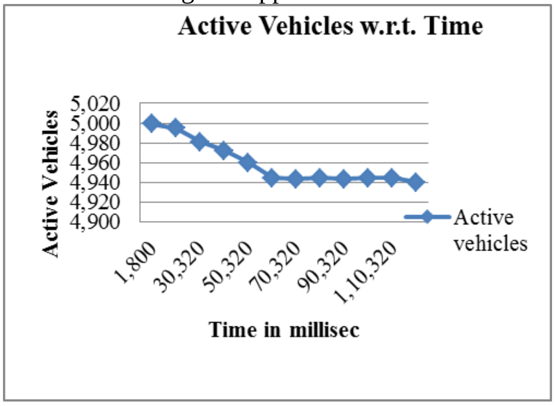

Fig. 2: Number of Active Vehicles vs. time

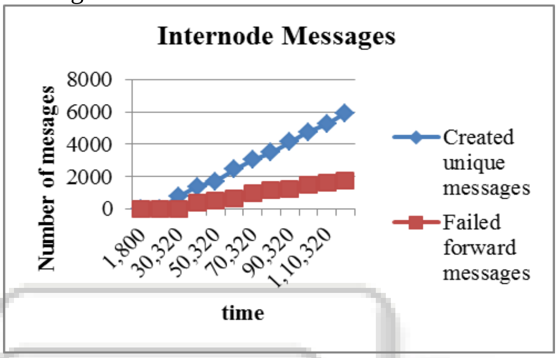

Fig. 3: Message drop vs. time

IX. Conclusion

We have been successful in achieving the following objectives that were set for this research work we have developed a VANET-Simulation scenario for supporting various VANET specific applications. The large spectrum of mobile distributed applications range from traffic alert dissemination and dynamic route planning to context-aware advertisement and file sharing. Made a simulation setup to allow large number of mobile nodes (vehicles), Considering the large number of nodes that participate in these networks and their high mobility. Designed and implemented an improved model for Intersection Based VANET Routing on actual City Roads (maps) from real world cities. City Maps was imported from XML files. The Algorithm developed is stable in nature and can provide consistent message delivery across the network.

References

[1] Blake, Roy. Wireless Communication Technology. Delmar Thomson Learning, 2000.
[2] Ku Jena, Rabindra. "Developments in Vehicular Ad-Hoc Network." International Review on Computers & Software 8, no. 3 (2013).
[3] MainakGhosh&SumitGoswami, IIT, Kharagpur on 1 February, 2009 – [available online]: http://www.pcquest.com/pcquest/news/181591/intelligent transportation-vanet
[4] Martinez, Francisco J., Chai KeongToh, Juan-Carlos Cano, Carlos T. Calafate, and Pietro Manzoni. "A survey and comparative study of simulators for vehicular ad hoc networks (VANETs)." Wireless Communications and Mobile Computing11, no. 7 (2011): 813-828.
[5] Bechler M, Franz WJ, Wolf L. Mobile Internet access in Fleet- Net. In VerteiltenSystemenKiVS 2003, 2003.
[6] Yoon J, Liu M, Noble B. Random waypoint considered harm- ful. Proceedings of IEEE INFOCOMM 2003, San Francisco, California, USA, 30 March–3 April 2003.
[7] Cabrera, Victor, Francisco J. Ros, and Pedro M. Ruiz. "Simulation-based study of common issues in vanet routing protocols."In Vehicular Technology Conference, 2009.VTC Spring 2009. IEEE 69th, pp. 1-5. IEEE, 2009.
[8] Sukumaran, Sangheethaa, Lakshmi Ramachandran, and Surya Rani Sunny. "STUDY OF VARIOUS GEOGRAPHIC ROUTING PROTOCOLS IN VANET."International Journal of Research in Wireless Systems 2, no. 1 (2013).
[9] Kohli, Sandhaya, Bandanjot Kaur, and Sabina Bindra. "A comparative study of Routing Protocols in VANET." Proceedings of ISCET (2010).
[10] Nzouonta, Josiane, Neeraj Rajgure, Guiling Wang, and Cristian Borcea. "VANET routing on city roads using real-time vehicular traffic information."Vehicular Technology, IEEE Transactions on 58, no. 7 (2009): 3609-3626
[11] Zhang, Zhensheng. "Routing in intermittently connected mobile ad hoc networks and delay tolerant networks: overview and challenges." Communications Surveys & Tutorials, IEEE 8, no. 1 (2006): 24-37.

