International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No. (01), January 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

IMPLEMENTATION OF VEHICLE NET IN IVCS BASED W-GRID USING OPNET SIMULATOR

S.Vigneshwaran[1] , Dr.R.Pugazendi[2]

[1]Asst.Professor of Computer Applications-UG

K.S.Rangasamy College of Arts and Science (Autonomous), Tiruchengode

[2]Asst.Professor, PG and Research

Department of Computer Science, Govt. Arts College (Autonomous),Salem-7

ABSTRACT

The performance of Mobile Ad-hoc Networks (MANET) for Inter-vehicular communications systems (IVCS) can be check with the public vehicle by using the actual traffic path patterns. The devices which attached to MANET are free to move independently in all the direction, and will therefore change its communication links to other devices without fail. Each node must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger Internet. Mobile nodes that are random and unpredictable. IVCS provide drivers and passengers with a range of services, and implementation of IVCS is made possible using MANET. However, certain differences in the properties of nodes affect the performance. This degradation of performance would be discussed in this paper through the various results that are received from OPNET simulations in a suggested Wide GRID (W-GRID) scenario that attempts to simulate the physical traffic situation in a street of any typical metropolitan environment. This approach utilizes the deterministic nature of vehicle routes or any other public transport system to incorporate a mobile backbone infrastructure that improves the performance of IVCS using MANET.

I INTRODUCTION

Nowadays, In the field of automotive industry Inter-vehicular communications are obtaining much interest. Using this IVCS the drivers could access with many services like identifying location, real-time traffic conditions, parking information, vehicle to vehicle chats, etc. On the other hand it could provide the passengers with the ability to browse the web, play games with friends in other vehicles, surf the social media etc. In order to implement IVCS, low power radio transceivers are suggested to implement onboard the vehicles. These transceivers communicate with each other in an ad-hoc pattern forming a MANET using the routing algorithms like reactive protocols DSR, AODV, etc to provide the route discovery, route maintenance and the transfer of data packets. While these routing protocols seem to work well in scenarios where nodes are basically random and mobile, the same could not be applied to IVCS as vehicular travel are often restricted by the roads and traffic patterns. The performance degradation is significantly large and this would be shown in the simulations based on the W-GRID as described in the later sections of this paper. This degradation of performance is due to the basic attributes of vehicular travel. However, on the other hand, some traffic patterns have been observed to be regular and deterministic. These patterns are usually created by public transportation services that travel, in most cases, fixed routes at regular known intervals. Examples of these include public buses, monorails, tramps, trains, etc. We would explore the effects of these regular patterns in our simulation and its significant improvement to the performance of MANET used in IVCS would be shown.

Finally, this paper would suggest some of the future works that would be carried out to exploit the predictability of regular traffic patterns provided by public vehicle services. This novel approach, which aims to improve the performance of the MANET with vehicular nodes, is named vehicle-Net.

II CRITERIA FOR MEASURING PERFORMANCE

There exist a few matrices that can be used to gauge the performance of MANET based on simulations of the network on the opnet network simulator.

These matrices include:

a**. Data Delivery Percentage:** This represents the total number of packets delivered over the total number of packets sent

b. **Routing protocol overhead**s: This represents the total size of all the control packets/bytes transmitted and forwarded over the total size of all data packets/bytes successfully transmitted

c. **End-to-End dela**y: This represents the total delay incurred by the successfully delivered packets

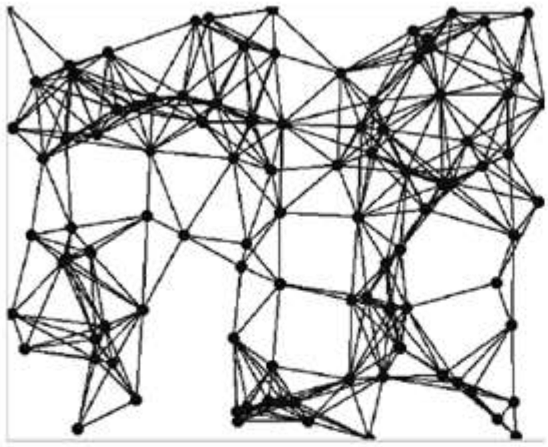
The performance of the MANET would be based on rate of data delivery in terms of transceiving percentages, as the major point of interest is to determine the reliability and robustness of the network used in IVCS. The general perception about the worthy communication and as long as data can be successfully transmitted from the source to destination vehicle, the time delays and overheads could not affect the vehicular application.

III THE W-GRID MOBILITY MODELS AND RANDOM NODES

Random nodes are usually assumed in most cases where MANETs are used. These random nodes which have almost-infinity range of freedom, move at random speeds within a certain range and travel un-predictable paths. Probably, in the case of IVCS, the nodes in the MANET differ as these nodes are generally made up of moving vehicles. Even though in large cases, vehicles do go at different speeds and take un-assumed paths, they are constrained by traffic patterns, conditions and entities like roads, streets, junctions, traffic lights, etc. Depending on different scenarios, the vehicle has different constraints on its degree of freedom. On a one-way street, vehicles have basically no choice but to travel along the street and on two way streets, vehicles have to follow 2 range of freedom given that a U-turn is allowed. The limitations on the degree of freedom a vehicular node can take and the length of the roads prevent vehicular nodes to be distributed evenly across the network, thus causing partitioning to occur. Another major entity that affects the vehicular nodes is traffic lights. Traffic signals impose certain restrictions on the vehicles. When the signal is red, the traffic facing the red light would have to stop. This property causes vehicles to cluster together and the cluster would be slowly distributed again into smaller clusters traveling in different directions depending on the range of freedom on the road once the light turns green. A higher degree of freedom would increase the probability of any 2 vehicles taking different paths after the junction. These properties contribute to the formation of small clusters in the ad-hoc network as compared to one without any restrictions on it nodes.

For the simulation of the random-waypoint scenario, nodes would be given a random destination and would travel at an arbitrary speed of 5m/s to 20m/s until they reach the destination. Once the destination is reached, the nodes would pause for 0 to 20 seconds before they select another random destination and speed. This process is then repeated until the end of the simulation. On the other side, in order to simulate the effect of vehicular nodes and its environment on MANET, the W-GRID scenario was established for carrying out the simulations. The WGRID basically models a typical metropolitan environment that consists of roads and junctions in the form of 500m x 500m square grids. Vehicular nodes must travel on the grid lines which represent the roads at speeds of 5m/s to 20m/s. Each grid intersection is treated as a junction where the vehicle would stop for a random period of time from 0 to 20 seconds before it proceeds in the next random direction. The radio range on the transceiver on board all nodes is 500m. Simulations are carried out to determine and compare the connectivity and performance between the random-waypoint scenario and the W-GRID over a spatial space of 300 seconds with random movement.
The connectivity diagram for the random-waypoint scenario and the W-GRID is shown in Fig.1 and Fig.2 respectively in 50 seconds interval with a total of 100 nodes in a 1600 x 2000 meter area. From the connectivity diagrams of the nodes in the random-waypoint scenarios shown in Figure 1 through Figure 5, it is easy to see that no partitioning is present in any of the snapshots. This means that all the nodes are inter-connected most of the time. The non-restricted movements also allow the nodes in the random waypoint scenario to be more evenly distributed. Thus clusters are usually large with connecting intermediate nodes between each cluster. Large clusters generally have higher delivery ratio as compared to small clusters as there is a higher probability that both source and destination node belongs to the same cluster.

International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No. (01), January 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354



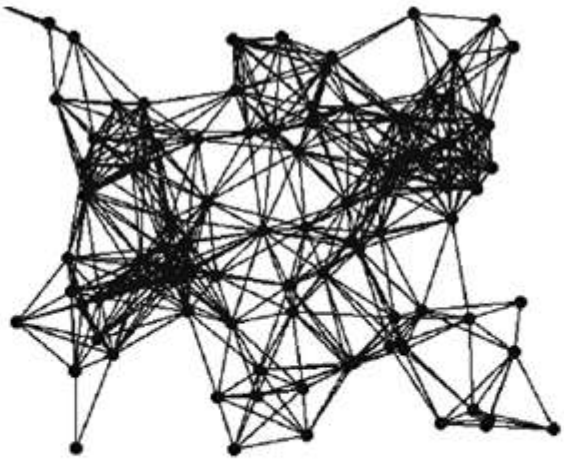
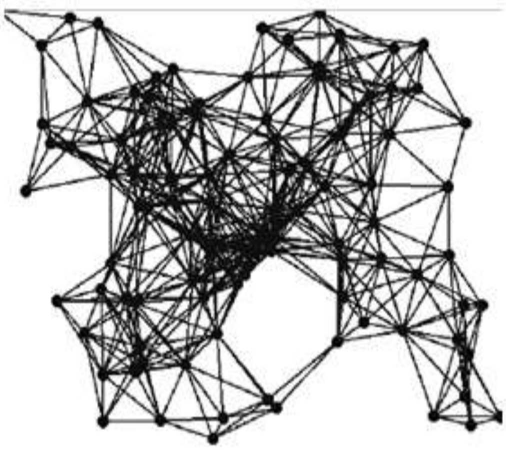


Figure 1. Random-Waypoint at time 0s **Figure 2. Random-Waypoint at time 50s**



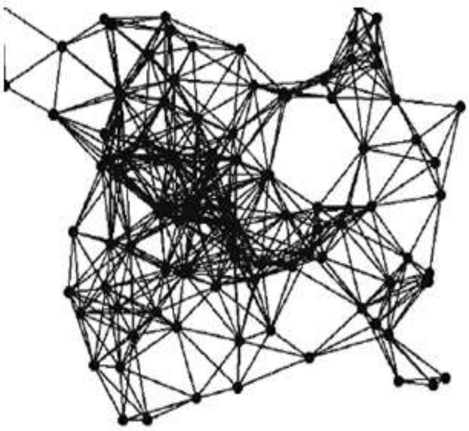


Figure 3. Random-Waypoint at time 100s **Figure 4. Random-Waypoint at time 150s**

Unlike the random waypoint scenario, movement of the nodes in the W-GRID is constrained by roads, junctions and traffic lights. These restrictions, as can be seen from the connectivity diagrams in Figure 6 through Figure 10, are the main reasons contributing to the partitioning of the nodes. More clustering are also observed in the W-GRID and these clusters are generally smaller than that in the random-waypoint scenario.

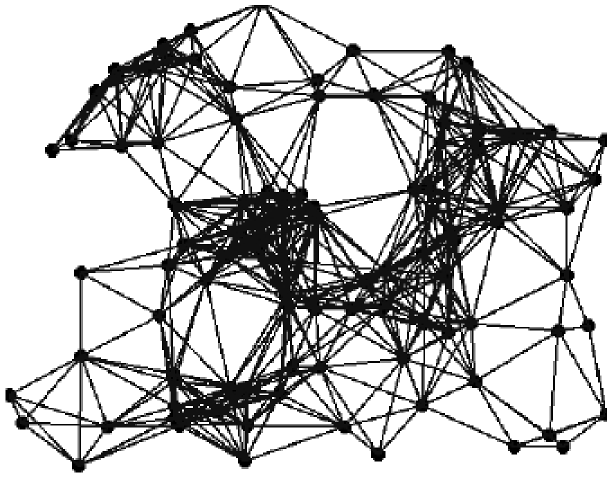


Figure 5. Random-Waypoint at time 200s

Thus each cluster also has a smaller area of coverage. The lack of intermediate nodes to link up the clusters causes heavy partitioning in the W-GRID.

Another approach was also carried out to investigate the effects of W-GRID on the vehicular nodes as compared to that of nodes in a random waypoint scenario. Connectivity of the scenarios was investigated by the generation of 100,000 different snapshots of the connectivity diagrams for each scenario, which shows nodes being randomly placed in each snapshot, taking into consideration the restrictions of the W-GRID. Through statistical calculations, the probability that a partition exists in the generated diagrams is then formulated, where a partition is said to exist if and only if there exists a node in the diagram that is not able to form a direct or in-direct connection with all other nodes in the network. The results of the investigation show that in the random-waypoint scenario, the probability percentage that a partition exists in the generated connectivity diagrams is only 10%, whereas in the case of the W-GRID, 60% of the generated connectivity diagram shows some form of partitioning. By the general definition of a partition stated above, it can be induced that a higher probability of partitioning would result in a higher probability that a source node would be unable to communicate with its destination node.

To further justify the performance degradation caused by the restrictions on vehicular movements, simulations are carried out in an area of 1600 x 1200 meters with 100 nodes to determine the delivery ratio of the two scenarios using Ad Hoc On-Demand Distance Vector Routing (AODV) [5] as the routing algorithm. The delivery ratio percentage is calculated as the number of data packets received by the destination divided over the number of data packets transmitted by the source. From the simulations, it is shown that that the average delivery ratio percentage

in the random-waypoint scenario was about 86.14% while in the W-GRID, it was only 96.15%. This shows that due to the increase in probability of partitioning, the number of data packets lost in the W-GRID is also significantly less than that of the random-waypoint scenario.

IJARSE
ISSN: 2319-8354

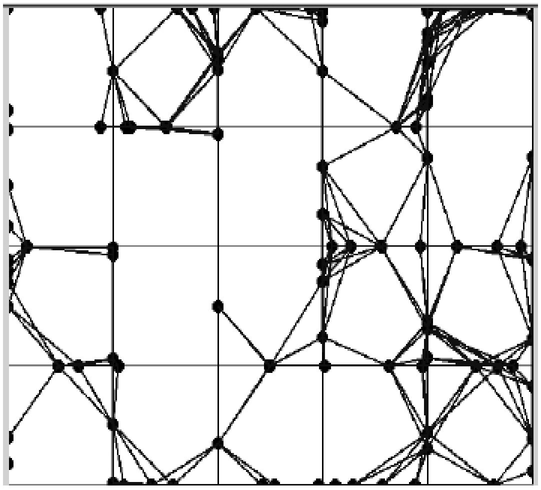


Figure 6. W-GRID at 0s

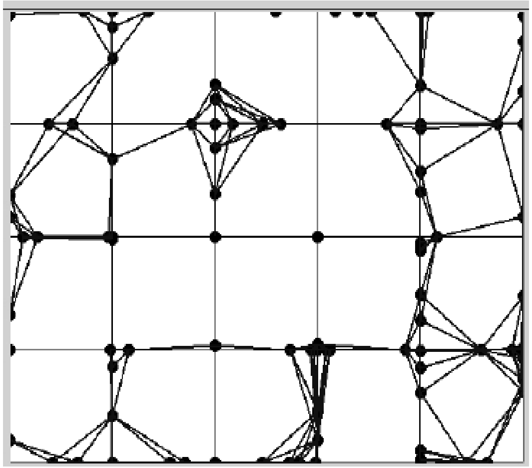


Figure 7. W-GRID at 50s

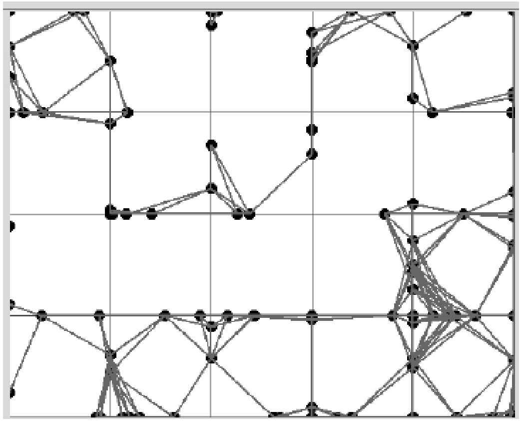


Figure 8. W-GRID at 100s

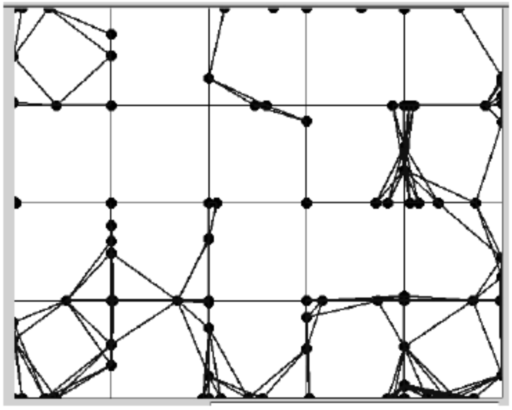


Figure 9. W-GRID at 150s

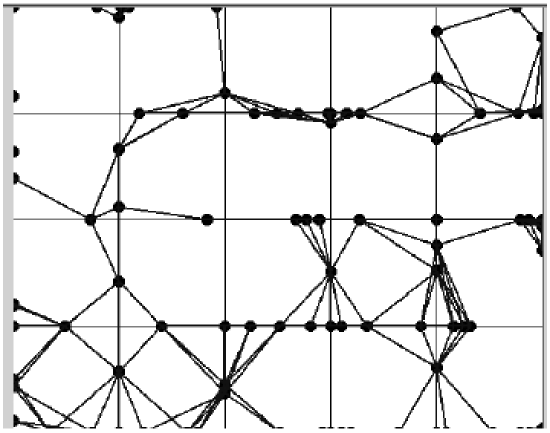


Figure 10. W-GRID at 200s

IV W-GRID PREDICTABLE ROUTES

From the previous section, it is discovered that due to constraints imposed by roads and traffic conditions, nodes in IVCS degrade MANET's performance in comparison to that of random nodes. The challenge now is to look at ways to improve the performance such that a MANET implementation of IVCS over a metropolitan coverage is still feasible. As mentioned, vehicular nodes have restricted direction of travel. However, not all vehicles have unpredictable routes. There exists a group of vehicles that has more predictable and regular path of travel. These vehicles include public transportation services like public buses, trams, trains, etc. In an attempt to make use of the deterministic property of these services, simulations are performed to determine the effects of such regularity in the W-GRID.

The scenario used for the simulations are as such. Three bus routes are inserted into a 1600 x 2000 meters W-GRID as shown in Figure 11. These bus routes are serviced by buses that were initially evenly distributed along each route at a minimum distance of 500 meters and traveling in alternating directions between each other.

To further enhance the realism of the simulation, bus stops are placed in the simulation scenario. Unlike the other vehicular nodes that emulate the cars and other private vehicles, the bus nodes simulate the effects of people lighting at bus-stops. Thus bus nodes would stop at each bus-stop along its route for the duration of 0 to 20 seconds. ideal dealy are inserted in the routes between junctions at equal distances. Thus, on the bus routes, it is assumed that the bus-stops are evenly distributed. Buses that service these routes travel at a random speed of 8m/s to 16m/s. A total of 100 vehicular nodes are placed into the W-GRID for the simulation.

Figure 11. object routes on the W—GRID The simulations were run for 200 seconds and the effect of having regular traffic can be seen from the results. With the buses included, the averaged delivery ratio percentage of the MANET is now 80.49%. This is a significant improvement of about 5.7% as compared to that of the W-GRID without buses. However, when compared to the random waypoint scenario, the delivery ratio is still quite low with a difference of about 13% in delivery ratio percentage.

V VEHICLENET

Having known the fact that regular traffic patterns can improve the performance of a vehicular MANET, a new architecture, named VehicleNet is suggested. The architecture attempts to exploit the advantages of this regularity to improve the performance of the MANET used in IVCS.

VehicleNet is basically a virtual mobile backbone infrastructure that is constructed using public buses. VehicleNet is a virtual infrastructure as it does not require the setup of any physical infrastructure. Thus it can be deployed rapidly into any metropolitan environment that has a regular public bus service. VehicleNet is mobile as the main nodes that form the VehicleNet backbone are moving buses. And lastly, VehicleNet is a backbone infrastructure as it is used to provide a reliable data bus for vehicles to interact with each other over a metropolitan coverage if needed. Figure 11 shows an overview of the VehicleNet architecture. The basic idea of VehicleNet is to provide a path for any two vehicles that are geographically far apart to intercommunicate with each other. For example, from Figure 11, Car E and Car A may be geographically far apart and through the VehicleNet, they are able to interact with one another. As it ispossible for the VehicleNet backbone to be the bottleneck of the network due to congestion, it is not required that all vehicular communications be made through the backbone. Vehicles are given the ability to intercommunicate without going through the backbone provided that there is a direct or shorter route between them. For example, intercommunications between VanC and Van B can be done directly instead of through the VehicleNet backbone.

The objective of VehicleNet is to develop a routing

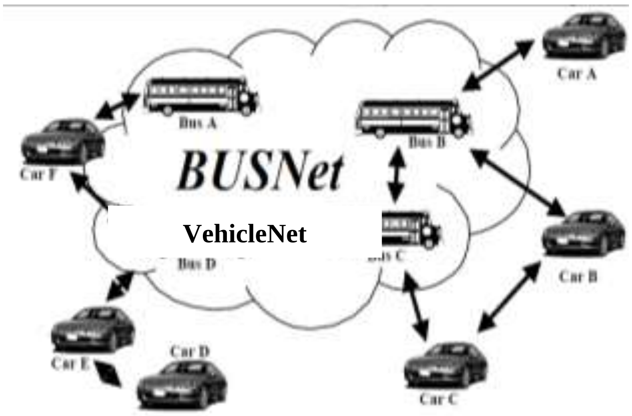


Figure 11. W-Grid simulation using opnet

Overview of the VehicleNet architecture algorithm that enables the public buses to form a highly reliable backbone infrastructure. At the time of this paper, works are being carried out in the development of this algorithm. The ultimate aim of the algorithm is to create, using the regular, deterministic and predictable nature of public bus services, a highly robust backbone infrastructure that would be as reliable or more reliable than placing static transceivers at each bus-stop along the bus routes. However, to simulate the effects of having such reliable backbone architecture, the bus-stops in the W-GRID would be converted into nodes and simulations would be carried out to observe the effects they have on inter-vehicular communications. As before, the simulation period is 200 seconds and communication is strictly between non-bus vehicles.

In other words, all source and destination vehicles are not nodes in the backbone of VehicleNet but must make use of the backbone in order for the data packet to be delivered. The simulation results show that the average delivery ratio percentage of such a setup is now 86.80%. This is a significant improvement of about 13.99% as compared to that of the W-GRID without buses. On the other hand, as compared to the random waypoint scenario, it is still about 6.34%

lower in delivery ratio percentage. In spite of this, one point to note is that it is possible for inter-bus communications. This is not included in the simulation above. Thus 86.80% is the lower bound for the inter-vehicular communications in VehicleNet , as the worst case communication scenario in VehicleNet would occur when any 2 non-bus vehicles communicate through the backbone infrastructure.

When simulations are carried out to determine the delivery ratio of bus-to-bus communications over a 200 second period, it is found that the average delivery ratio percentage is now 94.15%. This performance is about 1.2% better than that of the random waypoint scenario. This serves as the current upper bound for inter-vehicular communications in VehicleNet as the best case scenario in VehicleNet would occur when both source and destination nodes are buses. Delivery ratio percentages for other forms of inter-vehicular communication in the VehicleNet, for example, bus-to-car and car-to-bus communications should fall in between the lower and higher bounds stated.

VI FUTURE WORKS

Much work has to be done on the proposed VehicleNet and part of these works is currently under investigation. So far, this paper looked into and made used of the regularity of the bus services to provide for a mobile backbone. However, the deterministic and predictable properties of the bus services are not utilized in this paper as AODV is used as the routing protocol. By itself, AODV has no way of making use of these vital information. A novel routing protocol is currently under development and this protocol would make use of the deterministic and predictable property of the bus services to provide location awareness to both the buses and the other nodal vehicles such that the most optimal path can be established for inter-vehicular interactions. An interesting problem that is being concurrently researched is to improve the robustness of the backbone. In this paper, we have assumed that the backbone is robust to simulate its effects on the IVCS.

However, in reality, buses may not be within close proximity of each other. Thus there is a need to make use of linking non-bus vehicles to complete the VehicleNet. One example is shown in the figure, there exists a breakage between Bus A and the rest of the VehicleNet. In order to maintain the backbone, Car F must be used by the VehicleNet as the linking node. The selection of this linking node is also an interesting issue in the development of

VehicleNet.

Similar to the above problem, there is also a possibility that a non-bus vehicle, for example Car D, would want to communicate with another non-bus vehicle, for example Car A. Since Car D is not within the range of any bus, it has to create and maintain a route using linking vehicular nodes such that it can intercommunicate through these linking nodes to the VehicleNet and ultimately, to the destination node. The selection, establishment and maintenance of this route would also greatly affect the performance of the VehicleNet and thus, a suitable routing algorithm must

be developed to suit this need. Other than developments on the routing algorithm and architecture, more simulations and investigations would also be carried on VehicleNet to measure the performance of the network based on other matrices like the routing overheads and the end-to-end delays.

The resultant routing algorithm that is to be developed would also aim to improve the performance of MANET used in IVCS based on these matrices. Lastly, more real-life traffic behaviors are also being investigated and would be placed into the future simulations such that we are able to model real-life traffic conditions and patterns better, thus improving the reliability of the simulation results. This includes the possibility to simulate other road patterns like the Y-junctions, U-turns, etc, as well as entities like buildings along the road that would attenuate the radio signals, thus leading to more realistic simulation results.

VII CONCLUSION

In this paper, it was proved that the constrained movement patterns of vehicles degrade the performance of the MANET. It is then shown that regular traffic patterns can help improve the performance of IVCS. However, there is still more room for improvement. Knowing the fact that connectivity is highly maintained in regular bus routes, a mobile infrastructure formed by the usage of public bus routes and services named VehicleNet is introduced such that inter-vehicular interactions can be carried out over long distances and thus improving the performance of the MANET in the implementation of IVCS.

REFERENCES

[1] W. Franz, R. Eberhardt, and T. Luckenbach, "FleetNet - Internet on the Road", Proc. 8th World Congress on Intelligent Transportation Systems, Sydney, Australia, Oct. 2001.

[2] S. Yamada. "The Strategy and Deployment Plan for VICS", IEEE Communications, Vol.34, No. 10, pp.94-97, 1996.

[3] R. Morris, J. Jannotti, F. Kaashoek, J. Li, and D. Decouto, "CarNet: A Scalable Ad Hoc Wireless Network System", Proc. 9th ACM SIGOPS European Workshop, Sept. 2000.

[4] K. J. Wong, B. S. Lee, B. C. Seet, G. Liu, and L. Zhu, "BUSNet: Model and Usage of Regular Traffic Patterns in Mobile Ad Hoc Networks for Inter-Vehicular Communications", Proc. ICT 2003, Thailand, April, 2003.

[5] B. S. Lee, K. J. Wong, B. C. Seet, L. Zhu, and G. Liu, "Performance of Mobile Ad Hoc Network in Constrained Mobility Pattern", Proc. International Conference on Wireless Networks (ICWN'03), Las Vegas, USA, Jun. 2003.

[6] B. Karp and H. T. Kung, "GPSR: Greedy Perimeter Stateless Routing for Wireless Networks", Proc. ACM/IEEE MobiCom, Boston, USA, Aug. 2000.C. Lochert, H. Hartenstein, J. Tian, H. Füßler, D. Herrmann, and M. Mauve, "A Routing Strategy for Vehicular Ad Hoc Networks in City Environments", Proc. IEEE Intelligent Vehicles Symposium (IV2003), Ohio, USA, Jun. 2003.

[7] J. Tian, I. Stepanov, and K. Rothermel, "Spatial Aware Geographic Forwarding for Mobile Ad Hoc Networks", Proc. MobiHoc, Lausanne, Switzerland, Jun. 2002.

[8] L. Blazevic, S. Giordano, and J. Y. Le Boudec. "Self-Organizing Wide-Area Routing", Proc. SCI 2000/ISAS 2000, Orlando, USA, Jul. 2000.

[9] D. B. Johnson and D. A. Maltz, "Dynamic Source Routing Protocol for Mobile Ad Hoc Networks", Mobile Computing, T. Imielinski and H. Korth, Eds., Kluwer, 1996, pp. 153-81.

[10] P. Bose, P. Morin, I. Stojmenovic, and J. Urrutia, "Routing with Guaranteed Delivery in Ad Hoc Wireless Networks", Proc. 3rd ACM International Workshop on Discrete Algorithms and Methods for Mobile Computing and Communications (DIALM'99), Seattle, USA, Aug. 1999.

[11] A. Kamat and R. Prakash. "Effects of Link Stability and Directionality of Motion on Routing Algorithms in MANETs". Proc. IEEE International Conference on Computer Communications and Networks (ICCCN), Las Vegas, USA, Oct 2000.

[12] Raina, Ambica, Akhil Gupta, and Rakesh Kumar Jha. "Analysis of AODV and DSR Routing Protocols for a Static Ad Hoc Network Using OPNET Network Simulator." International Journal 4.1 (2014).