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PERFORMANCE EVALUATION AND ANALYSIS FOR VARIOUS ROUTING PROTOCOLS BASED ON XOR PROTOCOL IN VANETs

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Abstract: - This paper presents a performance analysis of various routing protocols considering Vehicular Ad hoc Networks (VANETs), formed in urban scenarios of high mobility. The protocols are; Destination-Sequenced Distance-Vector (DSDV), Greedy Perimeter Stateless Routing (GPSR), Zone Routing Protocol (ZRP), and the Exclusive-OR (XOR) protocol. The results of simulations allow us to characterize routing protocols performance through various aspects, such as duration of the path, End-to-End Delay, average number of hops in the path and Packet Delivery Rate.

VANET is consists of vehicles capable of exchange information by radio in order to improve road safety and enable internet access for passengers, our study have chosen as scenario. VANET is distinguished by a high mobility of nodes makes the network topology strongly dynamic. The aims of structural study of vehicle networks, is to study the dynamics road traffic through an analytical model and simulation. Also, show that in a VANET setting, DSDV is better than GPSR protocol for the reception rate. In addition, a purely ad hoc vehicle network is not viable for applications users and conclude on the need to pair it with infrastructure or hybrid network.

Keywords: VANET, Routing Protocol, XOR-based protocol, and Network Simulator (NS2).

1. Introduction

Routing in VANET networks is a very difficult problem that poses challenges for many researchers [1]. Therefore, to ensure that vehicles can communicate, we must define the routing protocol. In fact, when the terminals are not in a direct radio transmission range, routing is required to establish communication between vehicles.

Studies and analysis in the field of VANET is increasing in advancement and becoming a reality. VANET networks are self-organizing, where the level of mobility in generally high. Routing protocols for VANET must be able to provide high proportion of packet delivery rate and low delay end-to-end delivery of packets [2]. So, meet a variety of requirements such as safety, traffic efficiency, among others. The proposed routing protocols for VANET are classified into two groups. Topology and position. The protocols described in this paper based on the network topology are DSDV and GPSR.

These protocols were not designed for vehicular networks but for Furniture Ad hoc networks scenario where the network topology that more stable because there is no great variation of routes and speed as in VANET. The topology-based protocols consume large amounts of network bandwidth when the number of high and therefore need all the updated information network. The protocol based on geographical position to analyze GPSR. This

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protocol is not necessary to have knowledge of the entire network, but the destination is generating the appropriate path [3].

2. Aspects of the Problems

The message routing in vehicle networks is a big challenge that interests many researchers and Car manufacturers who treat several projects. By analyzing the applications and services provided in the vehicle networks, we can see that some applications such as monitoring cars, connecting to Internet, etc... Require the establishment of a point-to-point communication (unicast).

Other applications use one-to-many communications (Traffic Information, Message alert, etc...). Vehicle networks of communication architectures must incorporate routing mechanisms and dissemination of effective and appropriate data to meet needs of the proposed services and applications [4].

In general, routing protocols based on XOR protocol and VANETs will open the door to extend the field of new multimedia services. Essentially, it allows the provisioning of new and optimized services with effective QoS. The inter-vehicle communication applications massive data sharing (e.g. multimedia applications). First, the focuses on the problems associated with the reliability of data transfer paths (routing packets at the network layer). Also, interested in Management of data to be transmitted in the network. A data management mechanism at the application layer is indeed necessary to ensure better the use of the bandwidth. All of these studies is to ensure quality of Service at the network layer as well as at the level of the application layer [5].

The related simulation work on vehicular networks. It is dedicated to the modeling of mobility and radio propagation in vehicular networks. A describe in more recent work carried out in this context. The different modeling approaches are highlighted as well as the main parameters that must integrate mobility and radio propagation models to achieve the required level of realism and ensure the validity and reliability of simulation results.

3. Vehicles Ad hoc Networks

Routing protocols are very important role in VANET since all provided services, unicast or multicast, are based on multi-hop communications for routing data. File transfers and games. Multicast communication that used in applications security and traffic management such as collision warning and platooning. To realize the exchange, routing protocols use local information, the immediate neighborhood, or global on the entire network, year to determine the relay nodes involved in the routing of unicast communications data is typically used in applications comfort [6].

Vehicular networks as the main feature of high mobility, which leads to a dynamic topology. This characteristic makes the traditional routing protocols MANETs are mostly adapted to in VANETs. Indeed, in VANET, the speed can be much higher than MANETS in some communication environments such as highways. Various solutions for routing in VANET networks have been proposed, we distinguish two classes of routing protocols: protocols based Unicast (topology), which are divided into proactive protocols, reagents and hybrids, location-based protocols (geographical) using the physical position of the mobile nodes to set up the routing [7].

In a VANET, the nodes of the ad hoc network are vehicles traveling on a road or highway. This is an ad hoc network said highly mobile. Indeed, the difference between the speeds of the vehicles in that the network topology changes continuously and very quickly. Therefore, must again adapt routing mechanisms that particular context. Any such proactive protocols (protocols where roads are calculated in advance regardless of ongoing communications) are inapplicable because too many signaling messages are needed for the vision of the topology is current. A more robust approach is the use of reactive routing protocols: a discovery path is used only for the initiation of a communication. The road between the two communicating nodes is updated. Also, uses geographic protocols: routing decisions are made when routing data are only from the (location/destination) location [8].

Sum of individual driver behavior lead to practical vehicle paths. These paths are then introduced into a Network Simulator NS2, which allows us to compare the various existing protocols. These comparisons highlight the mechanisms that operate and weaknesses of existing routing protocols. One of the main perspectives of the use of VANET networks is to improve road safety. Find messages about accident-prone situations (black ice, significant slowdown, accident, etc.) are disseminated through the VANET network. These messages allow drivers to anticipate dangerous situations. The performance of protocols disseminating messages are paramount. The distribution must be reliable, fast and efficient (not to cause too much redundancy that could choke the network), the evaluation of performance of these protocols.

4. Overview of Routing Protocols in VANETs

To ensure vehicles can communicate, we must define the routing protocol. In fact, when the terminals are not in a direct radio transmission range, routing is required to establish communication between vehicles.
The compared different approaches to watch the performance of each depends heavily on conditions of use. Protocols building roads diffusion outperform their competitors when the number of active routes is low or when mobility in the network is high. However, because of the distributed nature, the environment and the complex topology of vehicular networks, the actual implementation can be difficult both economically and logistically shown in Table 1. The following routing protocols are analyzed in this study. We had selected three proactive, reactive, and hybrid routing protocols as DSDV, GPSR, and ZRP respectively for evaluation.

Table 1. Comparative Table of Routing Protocols

Effort performance	DSDV	GPSR	ZRP
Category	proactive	Geographical (reactive)	hybrid
Protocol type	Distance vector	Distance vector	undefined
Roads maintained in	Routing table	Table position	Routing table
The loop freedom	Yes	No	Yes
Multiple routes	Yes	No	Yes
Multicast	Yes	Yes	Yes
network overhead	Minimum	Medium	Medium
periodic broadcast	Possible	Possible	Possible
Requires data sequences	No	No	-
Roads reconfiguration method	Update packets. Stamped sequence number	Remove node is not in its area	It depends on the used reactive protocol
Summary	Information on the sequence number of destinations. Periodically sends to the neighboring routing table of totality.	Routing packets of data or control geographically. Used two modes: "Greedy Forwarding" the "Perimeter Forwarding". Determines the route to follow by minimizing the distances between nodes and destination.	Each node knows the neighbors, IARP to discover roads, IERP is used on demand to search the roads, BRP uses data supplied topology

4.1. DSDV protocol (Destination-Sequenced Distance-Vector): Is a routing protocol distance vector type, each node maintains a routing table containing information on the destinations accessible on the network. This information includes the following node used to reach the destination, the number of hops between the destination node and the sequence number stamped by the recipient. This sequence number to distinguish the new routes of old. Each node periodically sends to its neighbors its entire routing table. Other update packets are also sent in response to a change in the network topology. These packages include the entries in the table affected by the change and aim to propagate routing information as quickly as possible. When a node receives an update packet, it compares it with the existing information in its routing table. Any entry in the table is updated if the received information is newer (with a larger sequence number), or if they have the same sequence number but with a shorter distance.
In DSDV protocol, a mobile unit must wait until it receives the next update initiated by the destination in order to update the entry for that destination in the distance table. Therefore, the reaction DSDV changes the topology

is considered slow. Furthermore, this protocol causes significant load control in the network because of update packets sent periodically or in response to events [9].

4.2. GPSR protocol (Greedy Perimeter Stateless Routing): Is therefore a routing protocol based on the position, which contains two parts. The first is a method of selection of the next node transmitter that will act to retransmit packets, and it all based on the position information of neighbors (nodes candidates) and the destination of the packet. This method is to choose the candidate who is at a closest distance as the crow flies from the destination. The second part of GPSR is actually a method to bypass obstacles and empty geographical areas, which have no transmitter candidate in the neighborhood [10].

4.3. ZRP protocol (Zone Routing Protocol): Is a hybrid between a proactive and a reactive pattern. It is based on two procedures: IARP (intra-area routing protocol, named) and IERP (inter zone routing protocol, named) [11].
IARP is used only within the routing zone. This zone is defined for each node and has a radius of size corresponding to a value of number of jump. For example, for a node, if this value is "two" so all nodes having a distance greater than two jumps will not be out of the zone of that node. The nodes located at a distance of two nodes will be the device nodes to this node. The value should be set by the network administrator and is equivalent to each network node [8]. It is important because it determines the performance of ZRP protocol. Over a network is more unstable it is essential that the value is low. By sharing between intra-zone and inter-zone, changes in network topologies have only a local impact and is no longer reflected at the other end of the network, which reduces the use of network bandwidth [12].
IERP is responsible for establishing links with the nodes in the inter zone. For this, it relies on border casting techniques (via BRP Border cast Resolution Protocol) for sending a packet to all peripheral nodes. During a route request, IERP first checks that the recipient is not present in the intra-zone (no query, the source knows its contents). If it is present then no connection process is necessary [2]. However, if it is not there then the source makes a request for the establishment of road ("Route Request") to all device nodes. Device nodes, receiving the message, perform the same operation. Each node receiving the request registers its identifier within before returning, this is called the road accumulation. The device node containing the destination in its routing zone replied, using identifiers present in the request, with a "Route Reply" signal indicating the route to take to reach it. As a preferred type of query "Route Request" is not transmitted to a zone that has already been traveled, IERP uses two mechanisms. The first kill messages containing an identifier of this node in its intra-zone (except if of course the previous node). The following is a complementary mechanism that records the identifier of the host in its application list only in times of "Route Request" to ignore a request already made before [15].

5. Methodology

A comparing the four protocols mentioned. Will be presented results of the comparison of these three protocols in the situations described below:

5.1. The simulations

Any new solution goes through a process of evaluation and validation before its eventual deployment. The ideal way to accomplish this task is to perform tests in real environments. However, because of the distributed nature, the environment and the complex topology of vehicular networks and around this problem, the simulation is the most widely used means. Indeed, through simulation, design, analyze and evaluate the performance of any solution.
Network Simulator (NS) was used with implementations of the protocols DSDV, GPSR, ZRP, and XOR. Before starting the tests, we will present the movement scenarios we used in Table 2 as follow:

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Table 2. Movement Scenarios of Parameter Values Used for Simulation

Simulation Parameter	Parameter Values
Total Number of Nodes	20, 40, 60, 80, and 100 Sources
Source/Destination	Random Waypoint
Data Packet Rate	512 and 1000 bytes
Vehicle Acceleration	2.6 m/s^2
vehicle deceleration	4.5 m/s^2
Vehicle Max Speed	72 km/h
Simulation Time	100s, 300s, and 600s
Range of the Antenna	400 meters
Traffic Zone	Urban
Data Type	CBR and UDP
Mobility Model	Two-ray ground model, Road blocking
Routing Protocols	DSDV, GPSR, ZRP, and XOR
Mac Layer Protocol	IEEE 802.11 p
Network Simulator	NS-2 version 2.35

In each scenario were made ten separate simulations for each routing protocol.

5.2. Hardware Environment Used

We will detail the tools used in the realization of our simulation. The tests were guided in a virtual machine with the following configurations; Described in the Table 3:

Table 3. Configuring the development computer.

Tools Used	Details
Processor	Intel Core 2 Duo 3230M CPU 2.60GH
graphics Card	Intel HD Graphics 4000 ; NVIDIA GeForce 710M
RAM Memory	2 GB
HD	250 GB

It was necessary to use the virtual machine operating system the incompatibility of some software required for simulations with newer versions of the operating system.

5.3. Points assessed

The several measures that used to analyze the performance of routing protocols. These criteria are:

A- **Number of jumps:** the number of hops required for the package to travel between the origin and destination. Is calculated by dividing the number of packets received by the destination on the number of packets sent by the source application layer (i.e., Constant Bit Rate (CBR)). It specifies the packet loss rate, which limits the maximum network throughput. The better the ratio of delivery, the most complete and correct is the routing protocol [13];

B- **Duration of ways**: The duration in seconds of the paths formed. Duration (messages/second) is the total number of data packets delivered divided by the total time of simulation time. In this case, the flow of the routing protocol in terms of the number of messages delivered for one second is measured [14];

C- **Delay end-to-end**: The delay in establishing the path between the source and at the destination, measured in milliseconds. The average time from start to finish is the average time (in seconds) it takes for a data packet reaches the destination. This measure is calculated by subtracting "the time at which the first packet was transmitted by the source" of the "time at which the first packet has reached its destination." This includes any delays caused by buffering during route discovery latency, queuing at the interface queue delays broadcast to the MAC, the spread and transfer time. This is important to understand the delay introduced by the discovery of the way [15]; and

D- **Availability of ways**: the percentage of paths that were created successfully [4].

6. Performance Evaluation and Simulation Result

The performance of an ad hoc network protocol should be evaluated with the mobility model that is closest to the expected real scenario, which can facilitate the development of VANET network protocol. The performance of a VANET protocol should be evaluate with the mobility model that is closest to the expected real scenario, which can facilitate the development of VANET network protocol.

The simulation is widely recognized as the most effective technique for the analysis and design available to the designers and managers of complex systems. It can be apply in various fields, such as the analysis of service systems, production systems, natural systems, computer systems etc. This technique is currently experiencing a development. This is due both to the interest of theoretical modeling of simulated systems, as by the increasing need to simulate for VANET achievements of more and more complex.

The presentation of protocols DSDV, GPSR, ZRP, and XOR, considering the metric of estimation mentioned in Sections 5.3. The XOR protocol comes in four formations, varying the values of some of its configuration parameters, more specifically the parameters that determine N and H, correspondingly, the request number of entries in each of the positions of the routing table and the number of hops authorized messages signaling during the process of manufacturing of routing tables. The results are shown in Figure 1.

In Figure 1 (a) can be seen comparing the delayed end-to-end between the protocols. The protocol that maintained the best average in the three scenarios was the DSDV, followed by XOR N1H3. All formation of the XOR protocol had an alike average. The protocol ZRP had the worst presentation, growing the delay as the number of us is growing, especially in the scenario of 100 vehicles where its delay and large than doubly the GPSR. The numbers of hops that are needed to get the package to its origin and target shown in Figure 1 (d), present stability of the network.

With a number of hops, the path becomes more susceptible to fracture because the chance of a replace in the way or out of reach of the antenna and more. Thus, protocols GPSR and ZRP had the highest averages for the number of jumps in all scenarios. The configurations of the XOR protocol N1H1 and N1H2 exhibit growth in the number of jumps in averages of 40 and 60 in scenery, N1H3 Decreases in the all scenarios.

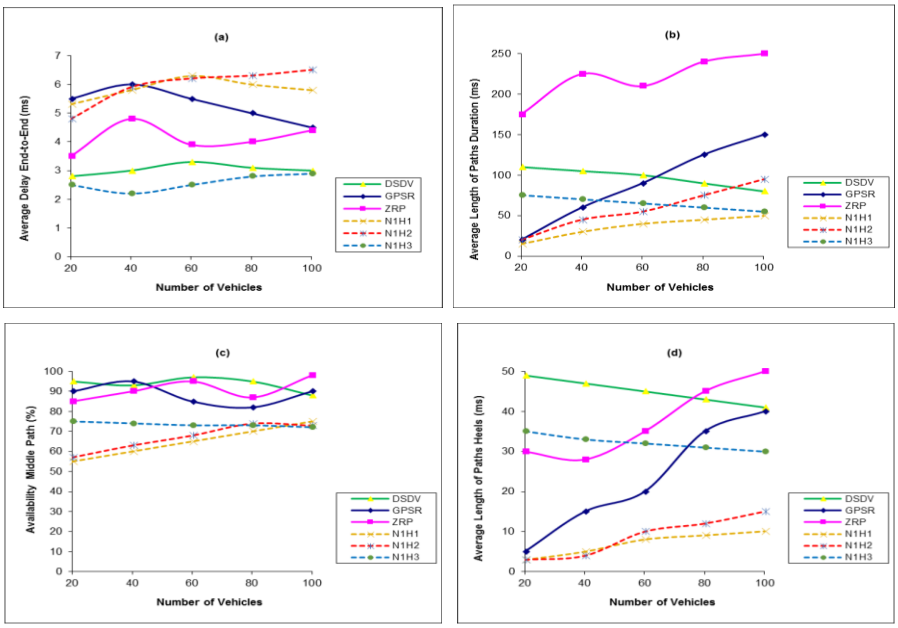

Figure 1. Results of (a) Average delay end-to-end, (b) Average length of paths, (c) Availability middle path, and (d) Average length of paths.

Figure 2 shows a comparison of the duration of the paths established by the protocols in scenarios with 20, 40, 60, 80 and 100 vehicles. The XOR-based protocol showed similar performance to DSDV and ZRP, which due to utilization of information logarithmic, requirement for construction of routing tables. In contrast, GPSR had the worst performance, especially in scenarios with larger number of vehicles.

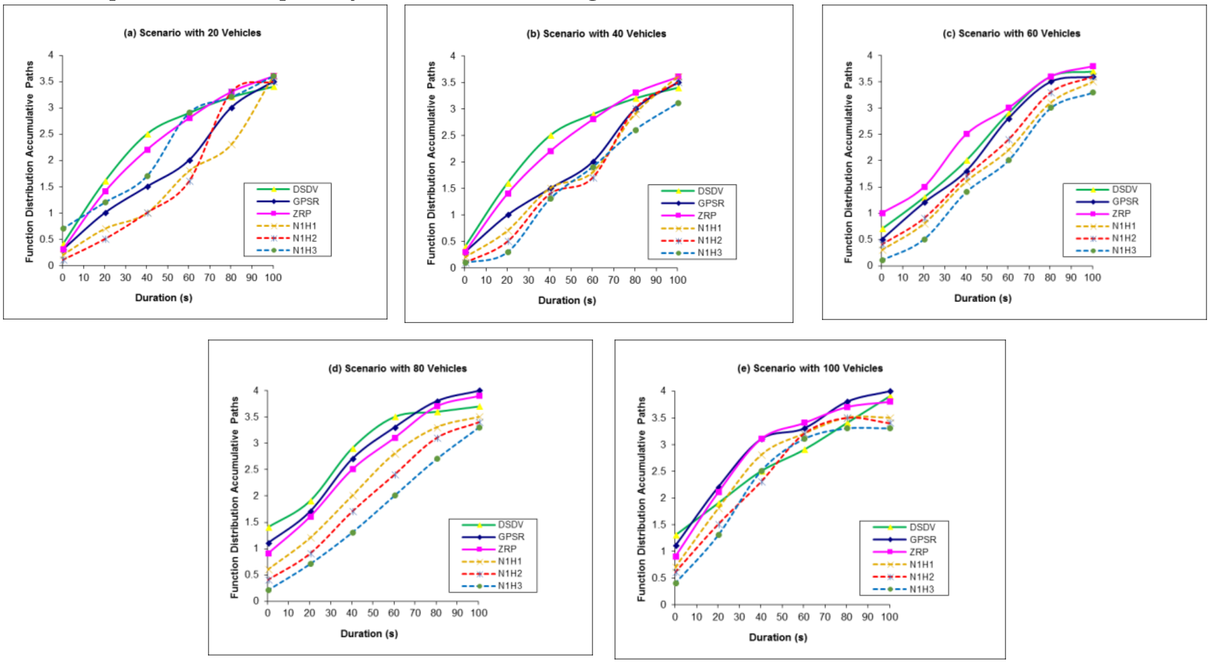

Figure 2. FDA (Function Distribution Accumulative).

7. Conclusion

The performance of routing protocols for vehicular networks DSDV, GPSR, ZRP, and XOR By using simulation mobile computing platforms software, which named NS2 (Network Simulator version 2.35). This study tested some routing protocols in vehicular network and have revealed that the over-head routing increases monotonically for protocols when the number of nodes increases and the routing protocol based on XOR-based, proved to be more reliable in terms of results routing and response time. Although XOR-based protocol is more reliable, the rest of routing protocols stay with a good performance and efficiency in the vehicular network.

Therefore, from the comparison and possible to study that despite the DSDV have good medias delay end-to-end path availability and number of jumps, there is a loss in the question of duration of ways, particularly in scenarios with larger number of vehicles. Thus, it was concluded that the XOR-based protocol, also to maintaining good media in all aspects of evaluation, and more scalable in relation to DSDV while supporting good results in addition in the duration of paths created. The XOR protocol will be further studied and improved scenarios in urban and motorway.

REFERENCES

[1] Z. C. Taysi and A. G. Yavuz, "**Routing Protocols for GeoNet: A Survey**", Intelligent Transportation Systems, IEEE Transactions on, vol. 13, pp. 939-954, 2012.

[2] E. P. F. Cruz, C. A. V. Campos, R. Pasquini, L. F . Faina, and R. Oliveira, "**Performance analysis of XOR-based routing in urban vehicular ad hoc networks**", In Wireless Communications and Networking Conference (WCNC), 2012 IEEE, pp. 2521-2525, 2012 .

[3] Sabih ur Rehman, M. Arif Khan, Tanveer A. Zia and Rashid H. Khokhar, "**A Synopsis of Simulation and Mobility Modeling in Vehicular Ad-hoc Networks (VANETs)**", IOSR Journal of Computer Engineering (IOSR-JCE), e-ISSN: 2278-0661, p- ISSN: 2278-8727Volume 15, Issue 2, PP 01-16, Nov - Dec 2013.

[4] Mrs. Uma Nagaraj, Ms. Poonam P. Dhamal, "**Performance Comparison of AODV, AOMDV, OLSR, DSR and GSR Routing Protocols in VANET**", UACEE International Journal of Advances in Computer Networks and its Security - ISSN 2250 – 3757 Volume 2: Issue 2, 2012.

[5] Mushtak Y. Gadkari, Nitin B. Sambre, "**VANET: Routing Protocols, Security Issues and Simulation Tools**", IOSR Journal of Computer Engineering (IOSRJCE), ISSN: 278-0661 Volume 3, Issue 3, PP 28-38, July-Aug. 2012.

[6] Y. M. Sharma and S. Mukherjee, "**Comparative Performance Exploration of AODV, DSDV & DSR routing protocols in Cluster Based VANET Environment**", International Journal of Advances in Engineering & Technology (IJAET), vol. 4, 2012.

[7] M. U. Nagaraj and M. P. P. Dhamal, "**Performance Comparison of AODV, AOMDV, OLSR, DSR and GSR Routing Protocols in VANET**", UACEE International Journal of Advances in Computer Networks and its Security, vol. 2, 2012.

[8] G. Z. Santoso and M. Kang, "**Performance analysis of AODV, DSDV and OLSR in a VANETs safety application scenario**", in Advanced Communication Technology (ICACT), 2012 14th International Conference on, pp. 57-60, 2012.

[9] Marwa Altayb, Imad Mahgoub, "**A Survey of Vehicular Ad Hoc Networks Routing Protocols**", International Journal of Innovation and Applied Studies ISSN 2028-9324 Vol. 3, no. 3, pp. 829-846, July 2013.

[10] Sabih ur Rehman, M. Arif Khan, Tanveer A. Zia and Rashid H. Khokhar, "**A Synopsis of Simulation and Mobility Modeling in Vehicular Ad-hoc Networks (VANETs)**", IOSR Journal of Computer Engineering (IOSR-JCE), e-ISSN: 2278-0661, p- ISSN: 2278-8727Volume 15, Issue 2, PP 01-16, Nov - Dec 2013.

[11] Sivasakthi M, Suresh S.R, "**Research on vehicular ad hoc networks (VANETs): An Overview**", Int. Journal of Applied Sciences and Engineering Research, Vol. 2, no. 1, ISSN 2277-8442, 2013.

[12] M. Altayeb and I. Mahgoub, "**A survey of vehicular ad hoc networks routing protocols**", International Journal of Innovation and Applied Studies, vol. 3, pp. 829-846, 2013.

[13] S. Zeadally, R. Hunt, Y. S. Chen, A. Irwin, and A. Hassan, "**Vehicular ad hoc networks (VANETs): status, results, and challenges**", Telecommunication Systems, vol. 50, no. 4, pp. 217–241, 2012.

[14] M. Slavik and I. Mahgoub, "**Spatial distribution and channel quality adaptive protocol for multi-hop wireless broadcast routing in VANET**", IEEE Transactions on Mobile Computing, vol. 12, no. 4, pp. 722–734, 2013.

[15] L. Chen, S. L. Ng, and G. Wang, "**Threshold anonymous announcement in VANETs**", IEEE Journal on Selected Areas in Communications, vol. 29, no. 3, pp. 605–615, 2011.