On The Selection Of Qos Provisioned Routing Protocol Through Realistic Channel For Vanet

Aarja Kaur, Jyoteesh Malhotra

Abstract: Vehicular Ad-Hoc Network (VANET) is a new communication paradigm creating a network on wheels. Communication between the vehicles provides for various safety and comfort applications. VANET is characterized by features like number of nodes, varying topology, constrained and high speed movement of nodes. All these features make routing in VANETs a crucial issue. This paper compares popular proactive, reactive and hybrid protocols in infrastructure less environments as availability of an infrastructure is not ubiquitous. Intensive simulations are carried out using IEEE 802.11p standard in the presence of realistic propagation model. Behaviour of protocols is studied in different situations by measuring performance in terms of QoS metrics like throughput , Packet delivery ratio (PDR), routing load and end to end delay.

Index Terms: QoS, VANET, AODV, OLSR, ZRP

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I. INTRODUCTION

Vehicular Ad-hoc Network (VANET) is a wireless ad-hoc network that is based on the concept of Mobile Ad-hoc Networks (MANETs) [4]. VANETs are self organising and self governing communication networks without any central coordinator [3]. In a VANET, vehicles are able to communicate with each other (V2V) or with a fixed infrastructure along the roadside (V2I). With the formation of these multi-hop networks among the moving vehicles, VANET addresses the major issues of traffic jams, road accidents that are a major concern in day today life [1]. It aims to provide Intelligent Transportation System (ITS) by its application for safety and non-safety purposes [4]. VANETs are challenging because they involve vehicles moving at high speeds that are confined by the road topologies and traffic signals. VANET also face frequent link breakages, changes in links, different density of vehicles depending on the type of environment [6].All these issues make data dissemination in VANETs elusive. Routing protocols are used to propagate information to the vehicles. The QoS provision is a major challenge in VANETs that necessitates the need to evaluate the performance of various routing protocols in different scenarios. A number of routing protocols have been proposed and evaluated for ad-hoc networks. In this paper, we analyze the performance of topology based routing protocols in infrastructure less VANETs because infrastructure support is not ubiquitous. The performance of three routing protocols one from each category of proactive, reactive and hybrid is investigated with respect to QoS parameters like throughput, packet delivery ratio (PDR), Routing load, end to end delay. The routing performance is studied over varying vehicular density, packet size and by using different modulation schemes. In order to achieve accurate and realistic results, the simulations are carried out on Network Simulator -2.The IEEE 802.11p standard and Nakagami propagation model is used to provide for a realistic vehicular environment.The main contribution of this paper to ascertain the effect of variations in the environment on the routing performance which can further aid in choosing a suitable protocol and development of efficient algorithms in future. The remainder of the paper is organised as follows. Section II presents a brief overview of topology based routing protocols considered. Section III presents the previous work done in comparing various routing protocols. Section IV presents the simulation environment. Section V discusses the results of the study. Section VI finally concludes the paper.

II. OVERVIEW OF ROUTING PROTOCOLS

A vast number of protocols have been developed and evaluated to suite VANET scenarios. This paper mainly concentrates on AODV, OLSR and ZRP routing protocols.

A. AODV (Ad-Hoc On Demand Distance Vector)

AODV is a type of reactive protocol. As the name suggests, AODV is an on-demand routing protocol i.e it starts the routing process as and when the need arises [1]. Whenever a vehicle is to communicate with the other, route discovery process is initiated by broadcasting Route Request (RREQ) packets to all the neighbour vehicles. The purpose of flooding the network with these packets is to discover a valid route to the destination. The neighbouring vehicles on receiving RREQ, further forward these to their neighbours and so on until a path to the destination node is formed. A Route Reply (RREP) message is sent back from the destination to the source which had generated the RREQ message [2]. Whenever there exists no valid path to the destination node or a node leaves the network, a Route Error (RERR) message is issued that helps to update the routing tables. In AODV, loops are prevented by the means of a sequence number which is carried with each packet in order to indicate the freshness of a route [4].

B. OLSR (Optimized Link State Routing)

It is a type of proactive protocol. OLSR optimizes the classical link state protocol by the concept of Multipoint Relays (MPR). Each node in the network chooses from among its neighbours a list of nodes as MPR. OLSR being a table driven protocol involves periodic exchanges of topology information with the nodes in the network. Two types of messages are used for this purpose [3]. HELO messages, used for link sensing and neighbourhood

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detection. Topology Control (TC) messages provide updates of the topology changes [2].These two types of messages are propagated through the network by only the nodes selected as MPR's. The nodes that are not in the MPR set of any node cannot retransmit the packets [1].

C. ZRP (Zone Routing Protocol)

It is a hybrid routing protocol. It utilizes the best features of the proactive and reactive routing schemes. The network is divided into zones or area: Intra-zone comprising of N-neighbourhood nodes and is defined for each node with a radius. Inter-zone corresponds to the rest of the network outside the intrazone [8]. Two procedures are applied for each of the zone. Intrazone Routing Protocol (IARP) is used inside the zones and applies a proactive routing algorithm. Interzone Routing Protocol (IERP) employs a reactive routing technique and is used for establishing connections between the zones [3].The separation of the network into zones overcomes the overhead of the proactive routing and initial route discovery delay of the reactive protocols as now the topology updates are confined locally and not globally throughout the network.

III. RELATED WORK

VANET has become a hot topic of research due to its wide variety of applications. A lot of previous work has been done to investigate the QoS performance of protocols. However, many contradictions prevail in the evaluations done previously and it is hard to conclude which is the best suited protocol in VANET.

[3] presents the performance comparison between reactive, proactive, hybrid and geographical routing protocols. Realistic simulations are done by coupling propagation model and mobility model. Results reveal that the proactive protocols, particularly DYMO is more suitable for VANET than others.[2] analyzes the performance of AODV, OLSR and ZRP protocols in security applications. The parameters –throughput, end to end delay and jitter are considered. Simulations are done in two scenarios: with and without wormhole attack. It is found that OLSR outperforms AODV and ZRP in case of wormhole attack. In [6] the authors focussed on position-based and topology based routing protocols. Realistic mobility traces are used for comparing AODV, DSR and LAR in city and highway environments. Position based routing protocols prove to be better than topology based. In [7] authors realized the importance of modulation in wireless networks. A model for implementing QPSK in NS-2 is presented. Further comparison between BPSK and QPSK modulation schemes is done to see the effect on data rate, error rate, SNR. QPSK appears to be a good candidate for different types of topologies from the results obtained.[10] examines the performance of On-demand routing protocols under varying conditions of mobility, propagation model and traffic. AOMDV shows better performance than AODV and DSR under high mobility. All the three protocols show similar performance at low mobility. In [1] the quality of video transmission over VANET is evaluated by considering AODV, DSDV and GPSR. Evaluation is done in terms of frame loss rate and PSNR. Results show that GPSR is a better choice for video transmission over VANET than AODV and DSDV. [5] deals with comparing the performance of three routing protocols namely, AODV, DSR and GPSR. The results are analyzed for different scenarios of variable node density, speed and pause time. It is concluded that no single protocol performs best in all the scenarios. However, in case of real time traffic, GPSR outperforms DSR and AODV and AODV is suitable for high mobility environments. [4] is an attempt to study the QoS performance of AODV and DSDV in vehicle to vehicle environment. Performance is measured in terms of path holding time, path breakage probability under variable node density, traffic rate situations. AODV comes up to be better than DSDV but rise in number of vehicles decreases its throughput. [9] In this paper the authors investigate the impact of two mobility models on the performance of AODV, AOMDV, DSDV and OLSR for safety applications in VANET. The authors conclude that the results of the four protocols were not satisfactory as per the QoS metrics considered. [10] is another effort towards comparing routing protocols AOMDV, ZRP and DSDV. From the results it is clear that AOMDV performs considerably well than the other two in terms of packet delivery ratio and at high density. The results of the analysis done by authors in [11] indicate that a protocol performs well for a particular QoS parameter but not for all the parameters considered. It is difficult to state a single best protocol among AODV, DSDV and MAODV that are compared.

IV. SIMULATION ENVIRONMENT

For the purpose of analyzing and evaluating the protocol performances, simulations are carried out using a popular discrete event simulator, NS-2 (Version 2.35).In order to investigate the QoS performance; three different scenarios are considered that is: varying the number of nodes, various packet sizes, using two different modulation schemes at the physical layer. The upcoming table will summarize the three simulation scenarios.

TABLE I. *Simulation Parameters*

Network Simulator	NS-2 (Version 2.35)
Wireless Terrain	1200x1200
Simulation Time	10 min
Routing Protocol	AODV,OLSR,ZRP
Vehicle Density	30,60,90
MAC	MAC 802_11 Ext
PHY	WirelessPhyExt
Radio Propagation Model	Nakagami
Data Traffic Source	UDP,CBR
Packet Size	256, 512,1024 Bytes
Modulation Scheme	BPSK,QPSK
Speed of Vehicle	10 m/s

Scenario 1: Varying the number of vehicles as 30, 60, 90
Scenario 2: Varying Packet Size as 256, 512, 1024 Bytes
Scenario 3: Varying Modulation Scheme used as BPSK, QPSK

V. RESULTS AND ANALYSIS

A. Performance analysis of Scenario1: Vehicle Density Variations

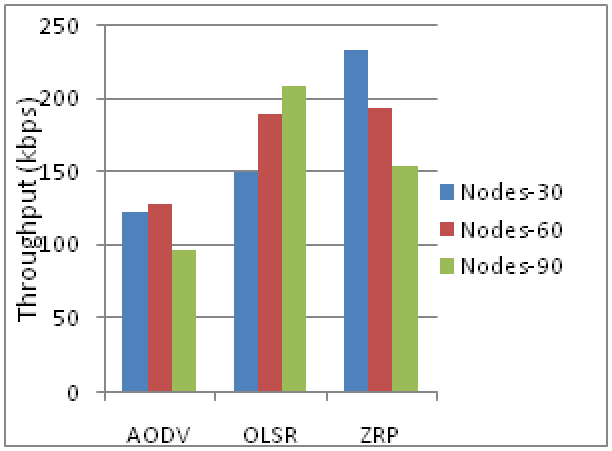

Fig. 1 *Throughput vs. Number of Nodes*

Figure above shows the throughput of AODV, OLSR and ZRP protocols. In case of node density 30, ZRP has the highest Throughput, OLSR has the average Throughput and AODV the lowest Throughput as compared to others. In case of node density 60, it is resuced for ZRP but increased for OLSR and AODV but still it is high for ZRP followed by OLSR. In case of node density 90, it is reduced for AODV and ZRP but increased for OLSR which has the highest Throughput.

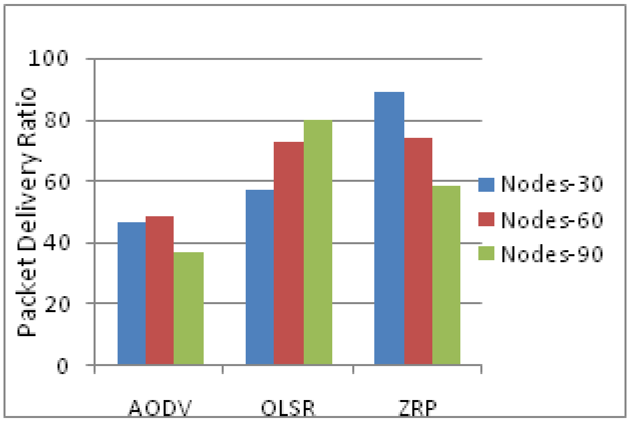

Fig. 2

Fig. 3 *Packet Delivery Ratio vs. Number of Nodes*

Figure above illustrates the PDR of AODV, OLSR and ZRP protocols with changing node density. In case of node density 30, ZRP has the highest PDR, OLSR has the average PDR and AODV the lowest PDR as compared to others. In case of node density 60, it is reduced for ZRP but increased for OLSR and AODV but still it is high for ZRP followed by OLSR. In case of node density 90, it is reduced for AODV and ZRP but increased for OLSR which has the highest PDR.

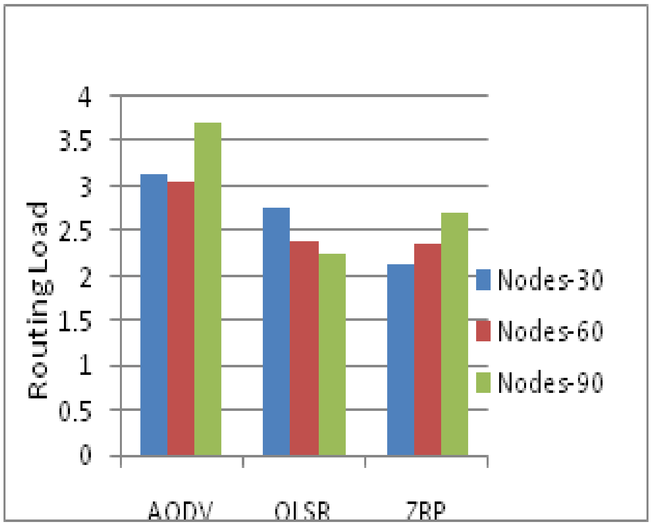

Fig. 4 *Routing Load vs. Number of Vehicles*

Figure above shows the Routing Load of AODV, OLSR and ZRP protocols. In case of node density, ZRP has minimum load with 30 nodes but it is increasing as per the node density vary. OLSR has the average level of load as per the node density variations. With minimum nodes it performs well and as the node density increases from 30 to 60/90, its load is also decreased. AODV has the highest load and it is continually increasing as per node density.

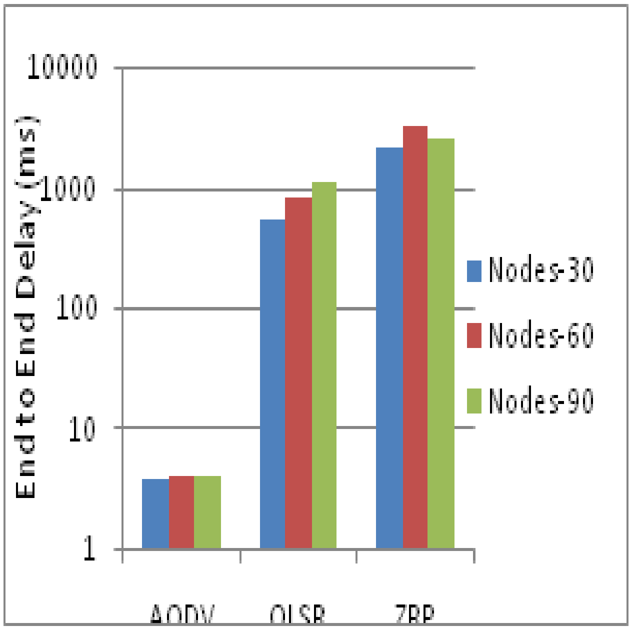

Fig. 5 *End to End delay vs. Number of Nodes*

The above figure shows the End-to-End-Delay of AODV, OLSR, ZRP protocols. AODV has constant delay as per node density variations and it is quite less as compared to others but OLSR and ZRP both have highest delay and there are variations in delay which are directly proportional to node density.

B. Performance analysis of Scenario 2: Packet Size variations

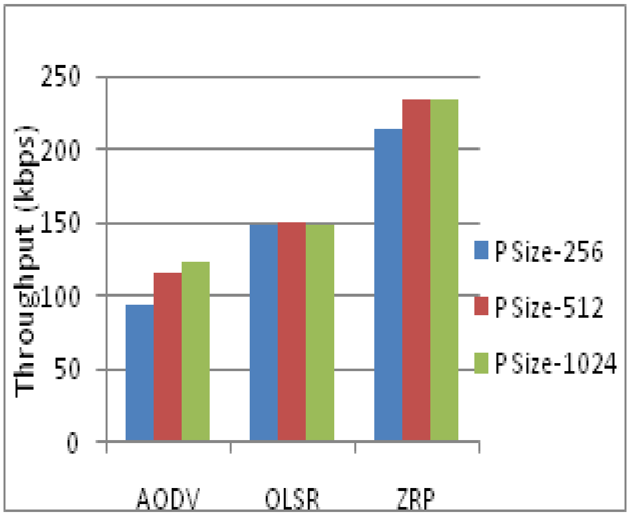

Fig. 6 *Throughput vs. Packet Size*

Figure shows the impact of packet size variations over Throughput of AODV, OLSR and ZRP protocols. In case of packet size 256 bytes, ZRP has the highest Throughput followed by OLSR and AODV has minimum Throughput. If packet size increases up to 512 bytes, then it is increasing for AODV and ZRP but slightly changes for OLSR. Using 1024 packet size, it remains same for ZRP and slightly decreases for OLSR and increases for AODV.

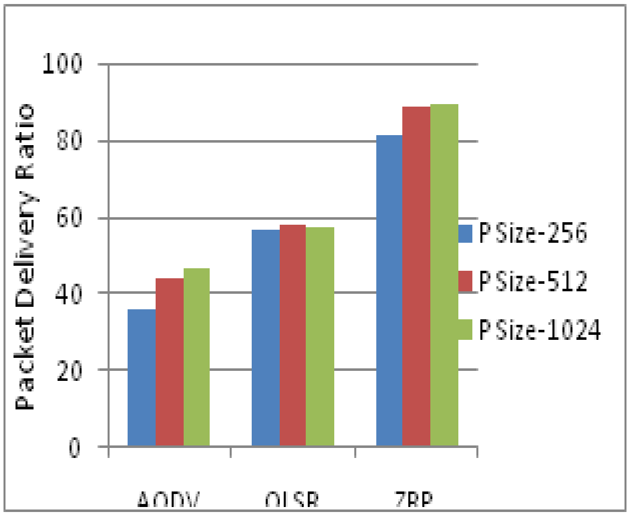

Fig. 7 *PDR vs. Packet Size*

Figure above shows the PDR of AODV, OLSR and ZRP with packet size variations In case of packet size 256 bytes, ZRP has the highest PDR followed by OLSR and AODV has minimum PDR. If packet size increases up to 512 bytes, then it is increasing for AODV and ZRP but slightly changes for OLSR. Using 1024 packet size, it remains same for ZRP and slightly decreases for OLSR and increases for AODV.

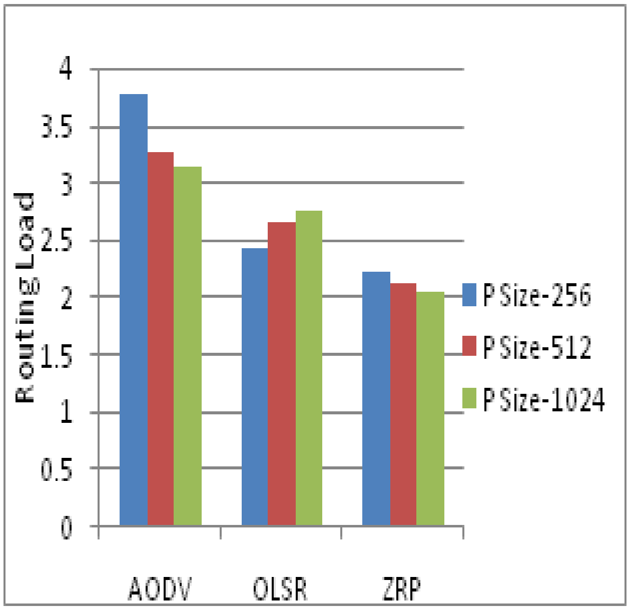

Fig. 8 *Routing Load vs. Packet Size*

From the results it is clear that in case of AODV, OLSR and ZRP, with packet size of 256 bytes, load is more for AODV but having average value for OLSR and ZRP but it reduces as packet size increase for AODV and ZRP but it increases for OLSR.

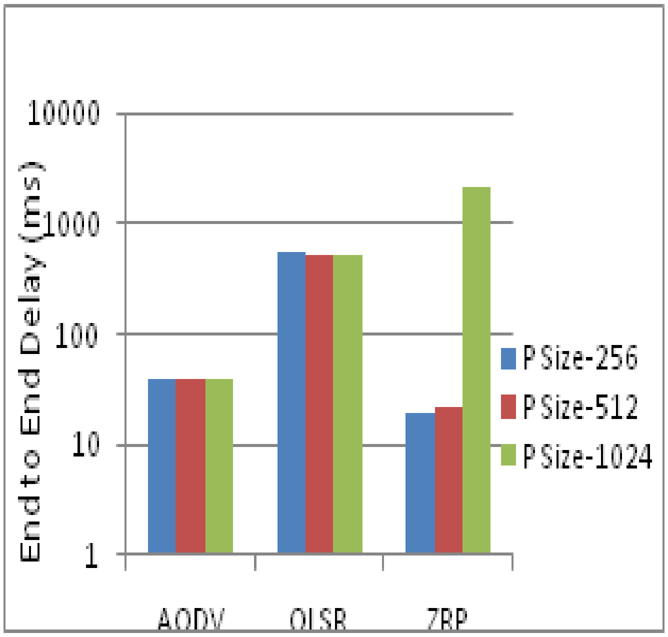

Fig. 9 *End to end delay vs. Packet Size*

The figure above shows the logarithmic graph of End-to-End-Delay of AODV, OLSR, ZRP protocols with varying packet size. For all packet size variations, delay remains almost constant for AODV which is less as compared to OLSR. ZRP shows an increase in delay as the packet size is increased. It suffers from high end to end delay when the packet size is 1024 bytes.

C. Performance analysis of Scenario 3: Modulations Schemes

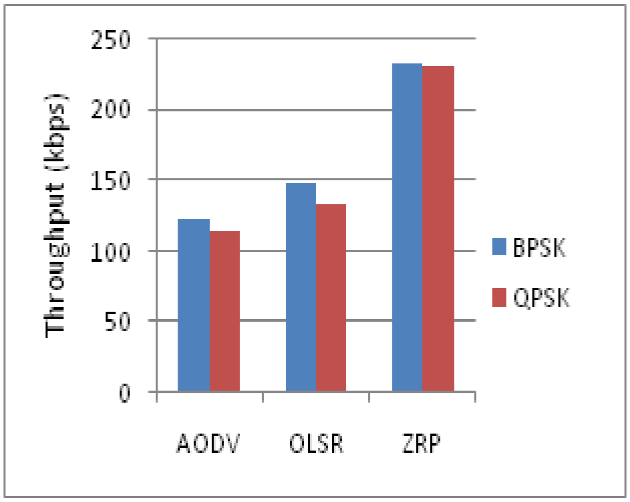

Fig. 10 *Throughput vs. Modulation Schemes*

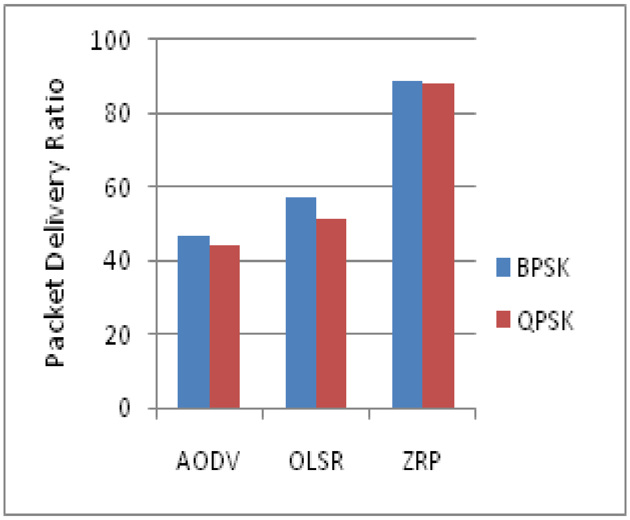

Fig. 11 *PDR vs. Modulation Schemes*

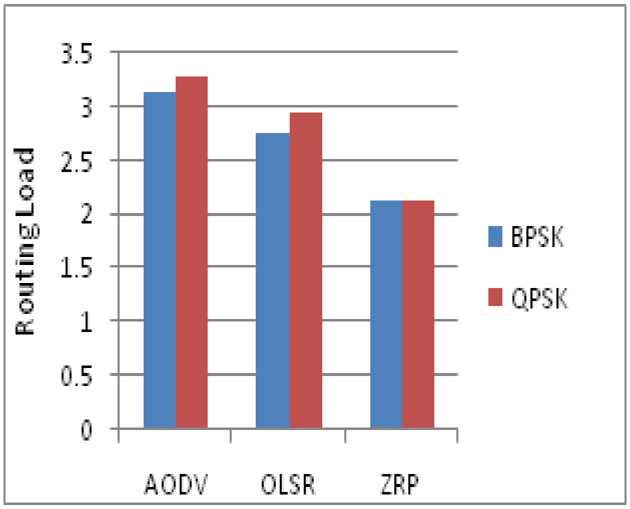

Fig. 12 *Routing Load vs. Modulation Schemes*

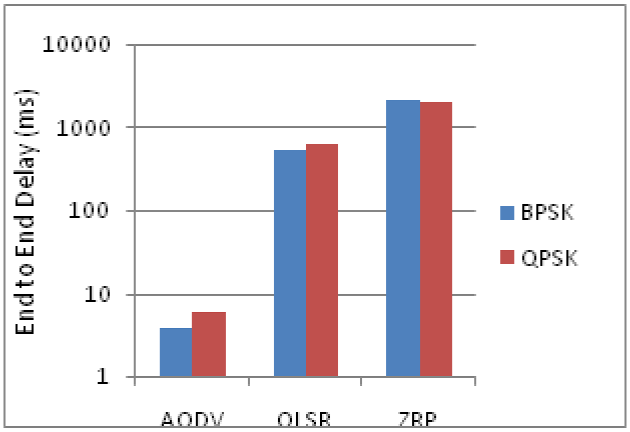

Fig. 13 *End to end delay vs. Modulation Schemes*

Figures 9, 10, 11 and 12 show the throughput, PDR, routing load and end to end delay of the three protocols respectively with respect to the modulation schemes. From the results it is clear that throughput, PDR of all the protocols is better when BPSK is employed as compared to QPSK. The routing load and end to end delay of the protocols increase when QPSK modulation technique is used.

VI. CONCLUSION AND FUTURE WORK

In this research work we did the performance analysis of various routing protocols that fall under different categories of reactive, proactive and hybrid. We used different constraints i.e. node density variation, packet size variation and modulation variation etc. with the mobility of 10m/s and with the Nakagami propagation model, in each case. We used NS-2 network simulator for simulation purpose. As per the result analysis, we can observe that performance of protocols suffers a lot with the variations of packet size, node density and modulation etc. AODV has the worst performance among all. In case of OLSR, its performance varies with the node density, packet size and different modulation schemes but it can adopt the network environment. ZRP out performs the protocols. In each simulation scenario, it shows its robustness. In case of node density, packet size variations and with different modulation schemes, Throughput, PDR, are increasing smoothly and load decreases but it has high .So finally we can say that performance of ZRP is better than the others followed by OLSR and AODV. This analysis work can be further extended to analyze the impact of variations over MAC layer and Physical Layer using MAC 802.11p, in order to enhance its performance.

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