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On the Selection of Queue Optimised Routing Protocol for VANET

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Abstract

VANET is one of the most escalating technologies that have been adopted due to its innovative applications and services. It has the potential to permit the vehicles on the roads to communicate intelligently in the absence of any fixed infrastructure. There are several challenges related to MAC and Routing Layer that needs attention for the intended implementation of VANET. Considering the challenge of optimisation of MAC Layer in VANET, work has been done here. The numerous Routing Protocols such as AODV, ADV, DSDV and GOD have been considered for the Cross layer Optimisation of 802.11b MAC Interface. The queue size has been optimised in terms of QoS parameters namely Throughput Rate, Packet Collision Rate, Packet Drop Rate and Broadcast Rate. The simulative investigations have been done for the aforementioned standard routing protocols by varying queue size and Optimised Routing Protocol for 802.11b MAC has also been identified.

1. Introduction

VANET is an important research area that is gaining importance in today's world. VANET aims in providing traffic efficiency, road safety along with comfort applications to the road users [1]. VANET is a primary part of Intelligent Transport System where vehicles act as sender, receiver as well as router at the same time [2]. The smart communication protocols guarantees fast and reliable delivery of necessary information to all the vehicles present in their range especially in an environment where communication medium has limited bandwidth and is unreliable [3]. The mobile nodes in VANET are the vehicles that vary their speed anytime. Hence they have dynamic topology. So Routing protocols play a very crucial role not only in determining the path from source to destination but also to provide accurate information timely. Keeping all the issues in mind, this paper investigates the performance of Reactive Routing protocol AODV, Proactive Routing Protocol DSDV and Hybrid Routing Protocol ADV and GOD. All the protocols have been compared on the basis of Queue Size. Queue Size defines the size of queue carrying data packets from source to destination successfully. The queue size has been varied gradually so that QOS Parameters are easily distinguishable. Here various queue sizes have been considered like 10,25,50,75,100 packets. Important QOS Parameters namely Packet Collision Rate, Packet Drop Rate, Broadcast Rate and Throughput Rate are used to differentiate the performance at variable queue sizes. In doing so GUI tool NCTUns 6.0[4] has been used.

The rest of the paper is organised as follows: Section II throws light on background of MAC Standards and Routing protocols; Section III describes Simulation Methodology and Environment; Results and Discussions are included in Section IV; at last Section V concludes the paper.

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2. Background

2.1. MAC Standards

In VANET communication technology, Vehicle to Vehicle Communication and Vehicle to Interface Communications are enabled through wireless access technologies [5]. For cooperative communication among vehicles protocols are classified in to five types namely Cellular Systems, Wi-Fi Standards, DSRC/ WAVE, CALM Standard and Miscellaneous Standards like Bluetooth, Zigbee *etc*. Wireless Fidelity Standards are popular due to their low cost, easy deployment and high data transfer rates. Wi-Fi standards like 802.11a, 802.11b, 802.11ac, 802.11e, 802.11g and 802.11n are very popular. In this paper medium range communication standard 802.11b MAC has been studied. Wi-Fi 802.11b MAC operates at 2.4 GHz frequency with data rate of 11Mbps and has high signal interference.

2.2. Routing Protocols

In the past few years routing has been extensively studied and evaluated. It has been studied that Routing Protocols play an important role in adhoc networks. Since VANET is a type of MANET, the traditional routing protocols of MANET have been simulated in VANET Environment using NCTUns 6.0. In order to determine MAC Optimised Routing Protocols for VANET using Queue size, protocols namely AODV (Adhoc on Demand Distance Vector Routing), ADV (Adaptive Distance Vector Routing), DSDV (Destination Sequenced Distance Vector Routing) and GOD (General Operation Directory algorithm) have been extensively studied.

3. Simulation Methodology

In VANET a simulator is required that has both network and traffic simulations capabilities and NCTUns 6.0 provides this platform [4]. NCTUns 6.0 has been used for computing the desired performance bounds in the selection of QOS Optimised Routing Protocol for VANET. The following subsections describe the performance parameters and scenario used to carry out simulations over a complete duration of 400 seconds in this research work.

3.1. Performance Parameters

The following QOS Parameters have been used to evaluate various routing protocols at different queue sizes.

- ***Packet Collision Rate:*** It may be defined as the number of packets collided during transmission and as a result could not reach the destination successfully. For achieving better performance collision rate should be low.
- ***Packet Drop Rate:*** It may be defined as the number of packet dropped per unit time. As the packet drop rate increases, throughput decreases.
- ***Throughput Rate*:** It may be defined as the number of packets delivered successfully in a communication network. More are the packets delivered from source to destination more enhanced is the performance. It is calculated as:

$$T = \frac{N * P_s}{T_s} \quad [6]$$

Where
T= Throughput
N= Number of packet delivered at destination
P_s= Packet Size

T_s= Total time

- ***Broadcast Rate:*** It may be defined as the total number of incoming and outgoing packets broadcasted in a communication medium from source to destination node.

3.2. Simulation Scenario

The following Table 1 represent the simulation parameters that have been used in the construction of simulation scenario. The scenario consists of road network on which Multi Interface Car moves, 802.11b access points, mobile adhoc nodes and a host computer. All these components have been incorporated using ‘Draw’ Topology feature of NCTUns. The parameters in table 1 have been modified using ‘Edit’ interface in NCTUns 6.0 toolbar workplace. After that simulations are performed for 400 seconds using ‘Run’ toolbar interface. The scenario is shown in Figure 1.

Table 1. Simulation Parameters

Parameters	Values
NCTUns Version	6.0
Routing Protocols	AODV, ADV, DSDV, GOD
Traffic Tool	stg, rtg
Speed(Kmph)	32
Channel Type	Wireless LAN(adhoc)
MAC Protocol	802.11b
Frequency(MHz)	2400
Antenna Gain(dpi)	1
Transmission Power(dpm)	15
Street Width(meters)	30
Simulation time(seconds)	400

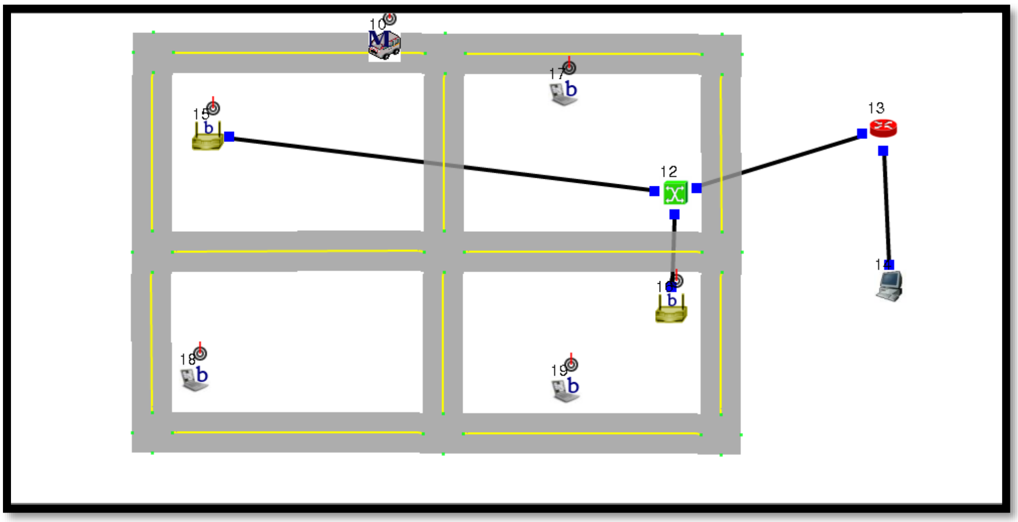

Figure 1. Simulation Scenario

Based upon the above scenario, four routing protocols namely AODV, ADV, DSDV and GOD have been evaluated at four different queue sizes in terms of standard QoS parameters as explained in next section.

4. Results and Discussion

The graphs shown below depict the performance of various routing protocols at four different queue sizes on the basis of standard QOS Parameters.

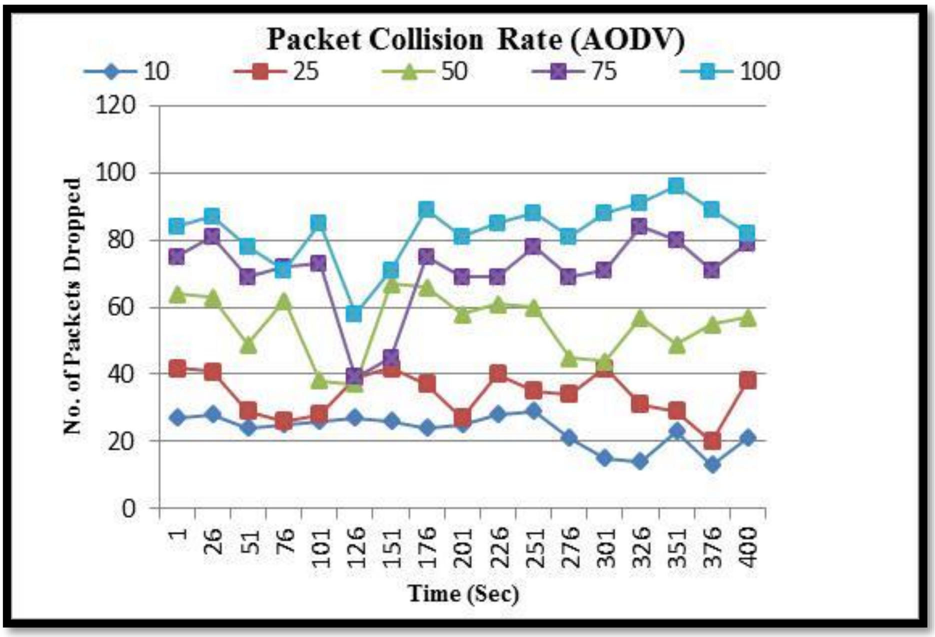

Figure 2. Packet Collision Rate using AODV Protocol

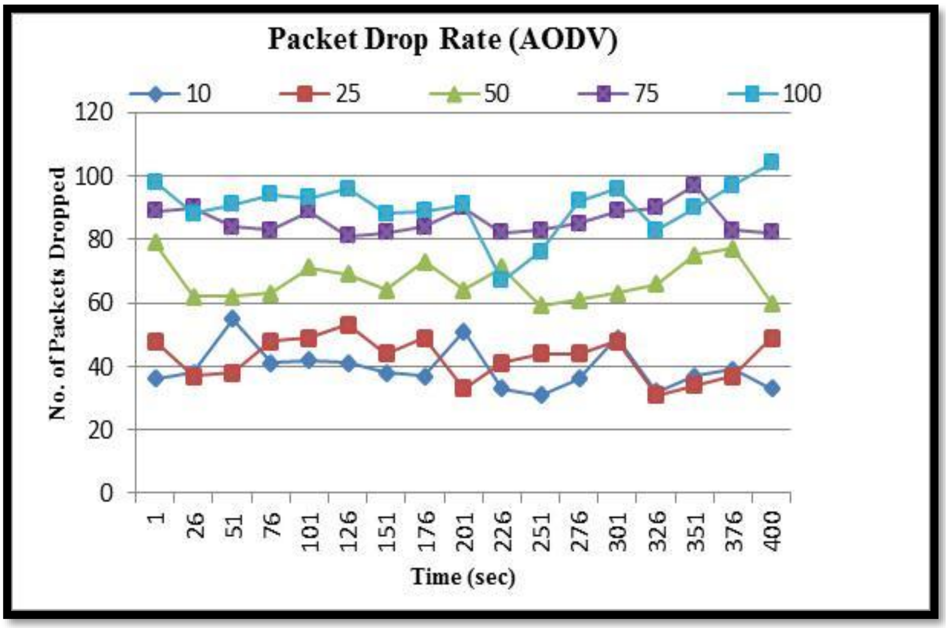

Figure 3. Packet Drop Rate using AODV Protocol

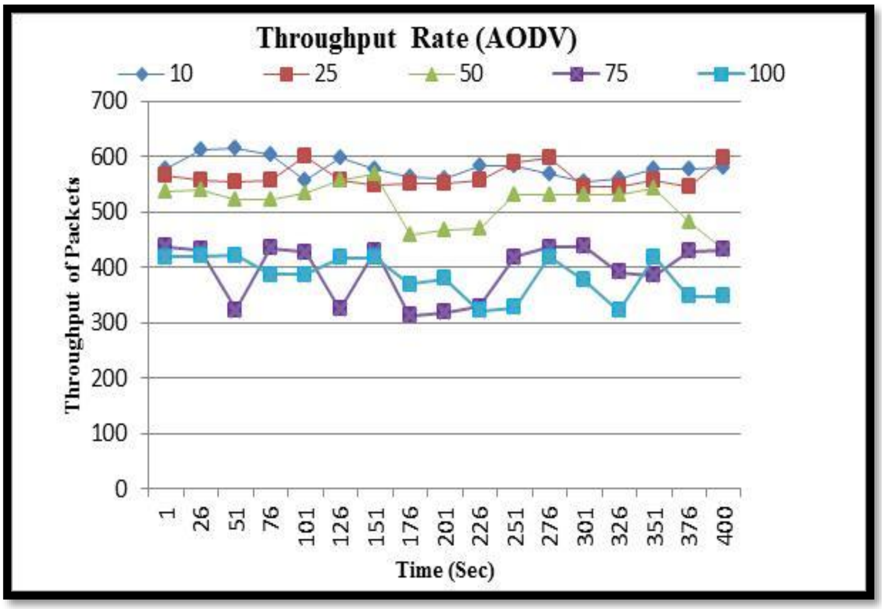

Figure 4. Throughput Rate using AODV Protocol

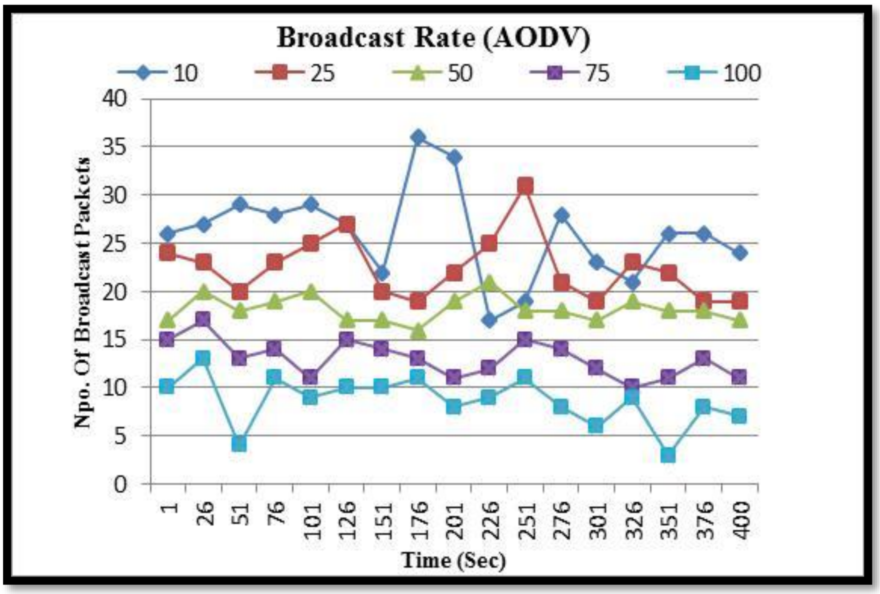

Figure 5. Broadcast Rate using AODV Protocol

The above Figures 2-5 depict the performance of AODV Protocol at five different queue sizes *i.e.*, 10,25,50,75 and 100 packets. Through extensive simulations it has been determined that acceptable results are achieved at smaller queue sizes. Small queue length shows lesser no. of collisions and packet drop rate and enhanced throughput and broadcast rate whereas larger queue length has lesser throughput rate due to large number of packet collision rate and packet drop rate. Hence optimal results for AODV Routing protocol are achieved at smaller queue size.

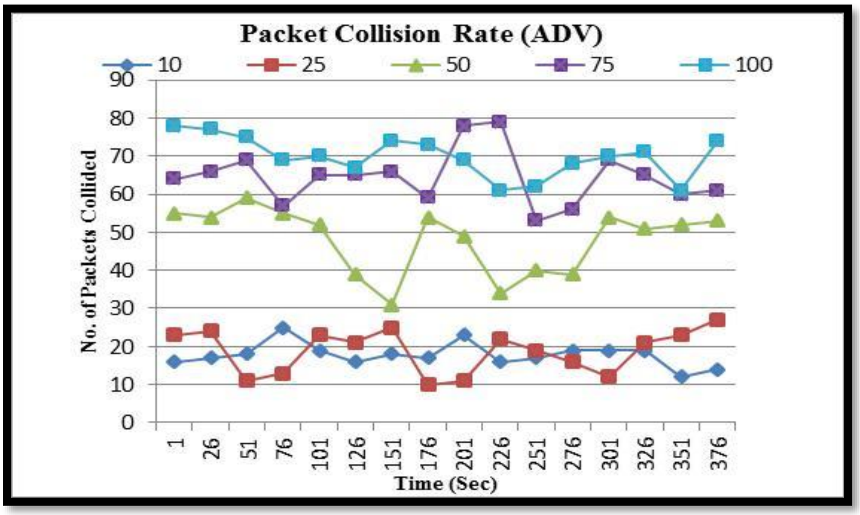

Figure 6. Packet Collision Rate using ADV Protocol

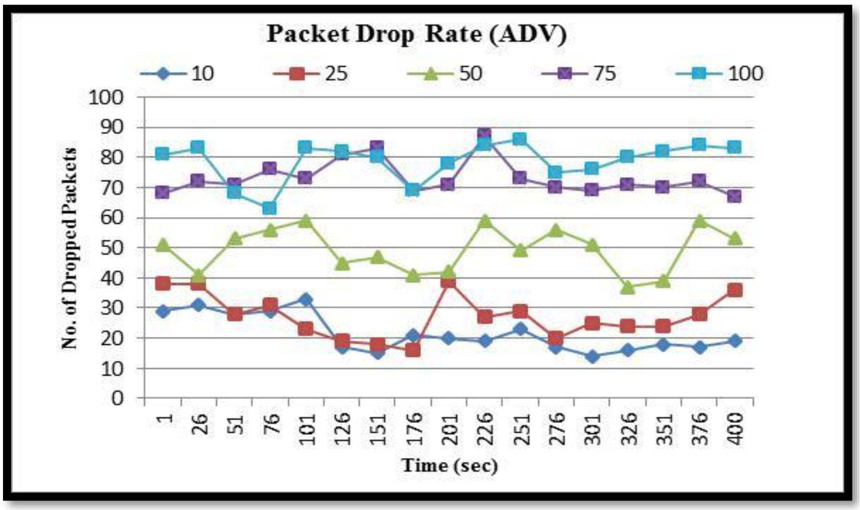

Figure 7. Packet Drop Rate using ADV Protocol

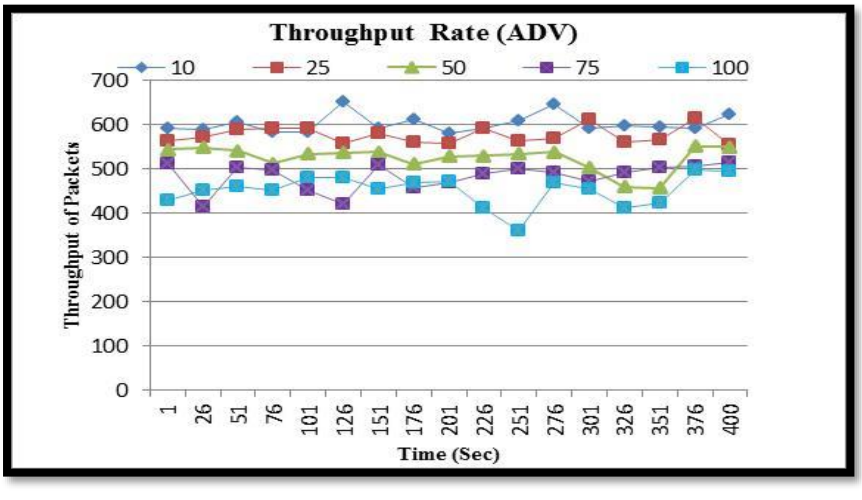

Figure 8. Throughput Rate using ADV Protocol

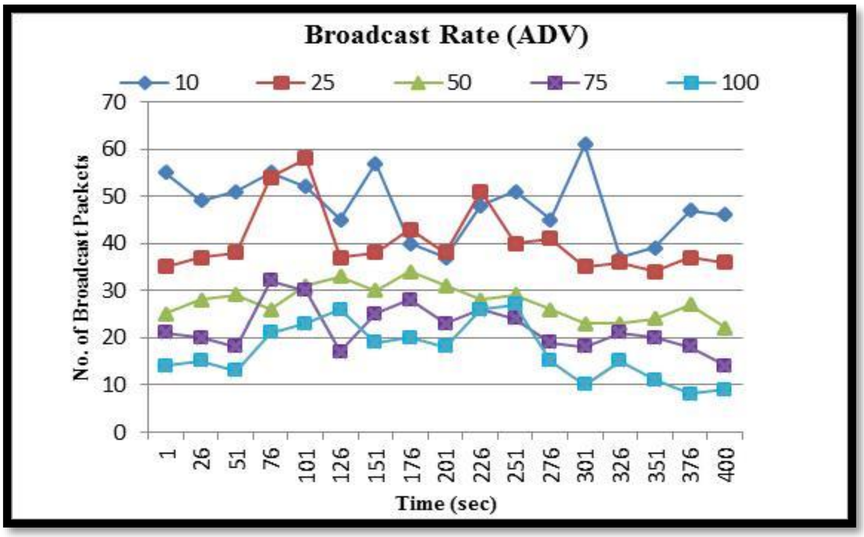

Figure 9. Broadcast Rate using ADV Protocol

The above Figures 6-9 depict the performance of ADV- a hybrid routing protocol. It is clear from the above graphs that Packet Collision Rate and Packet Drop Rate are superior to AODV routing protocol at all the queue sizes. Also the throughput rate achieved is ideal. As greater is the throughput, enriched is the performance. In comparison to the other routing protocols, throughput rate and broadcast rate achieved in this protocol are superior.

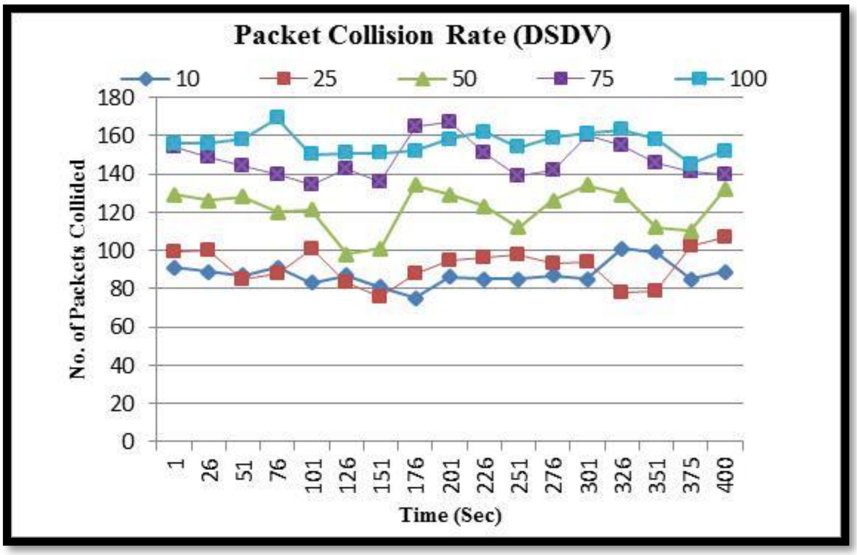

Figure 10. Packet Collision Rate using DSDV Protocol

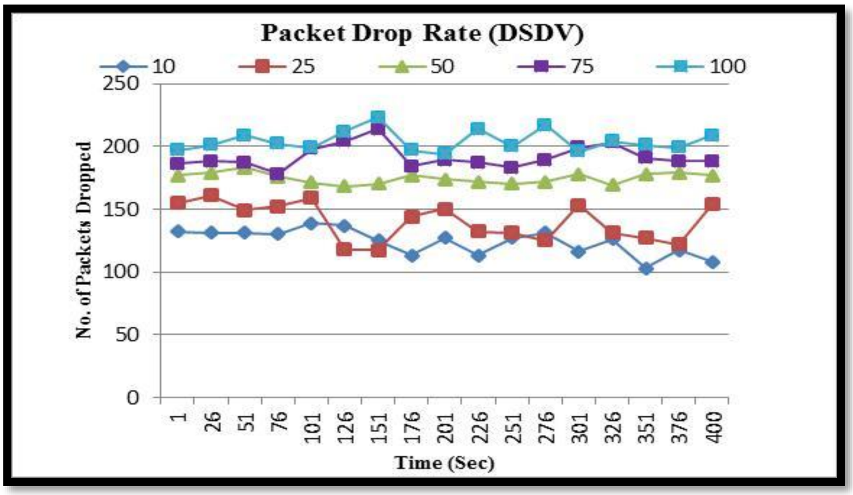

Figure 11. Packet Drop Rate using DSDV Protocol

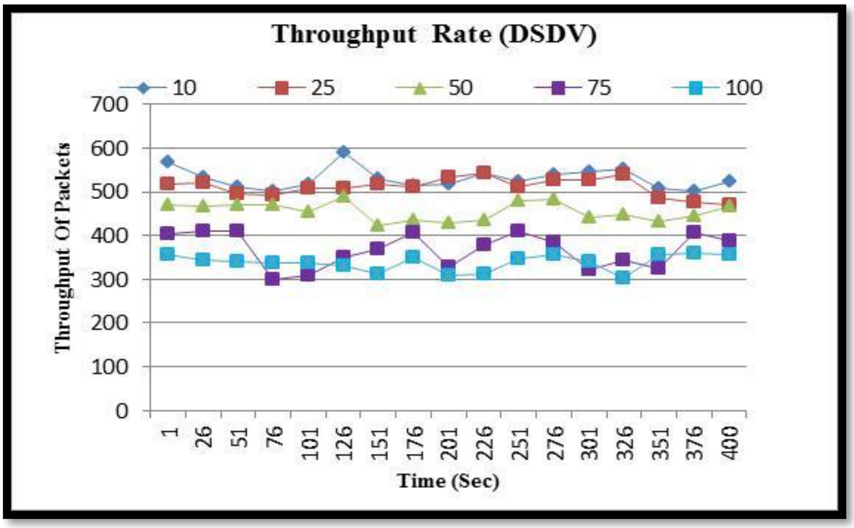

Figure 12. Throughput Rate using DSDV Protocol

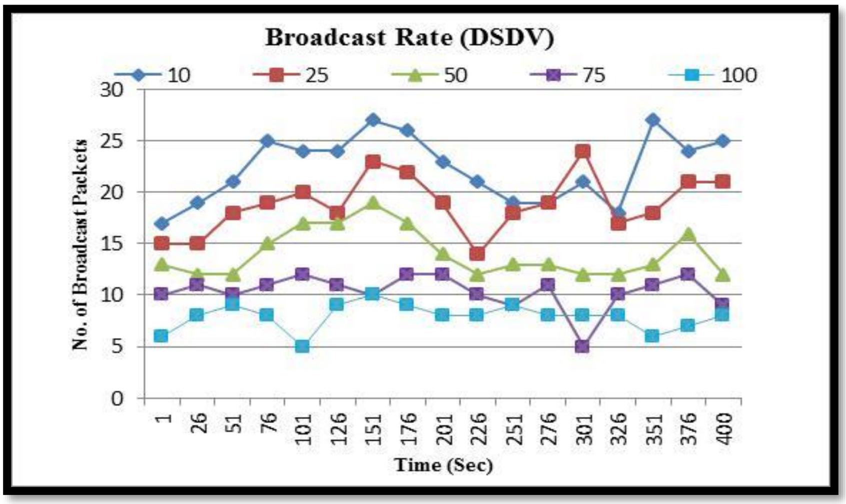

Figure 13. Broadcast Rate using DSDV Protocol

The above Figures 10-13 show the performance parameters behavior in DSDV Routing Protocol. Due to proactive routing strategy, performance parameters of DSDV show maximum degradation in terms of greater PCR, PDR and lesser throughput rate. This table based routing protocol shows the degradation in its performance in comparison to AODV and ADV. Yet all the graphs determine that when queue length is small Throughput Rate and Broadcast Rate is high. As the queue size increases, the performance of Routing Protocols starts degrading.

Hence it is concluded that for ADV, AODV and DSDV Routing Protocols the best results are achieved at smaller queue sizes. Optimum queue size selected for aforementioned protocols is 10 packets.

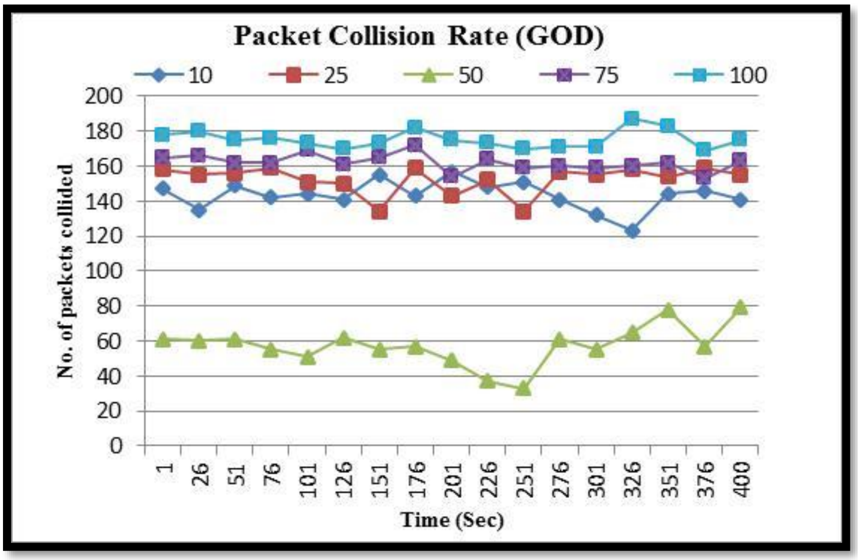

Figure 14. Packet Collision Rate using GOD Protocol

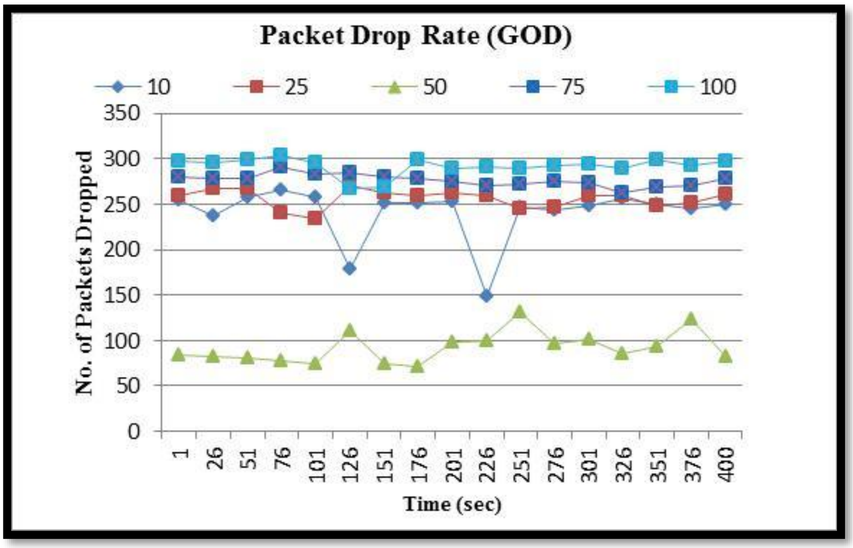

Figure 15. Packet Drop Rate using GOD Protocol

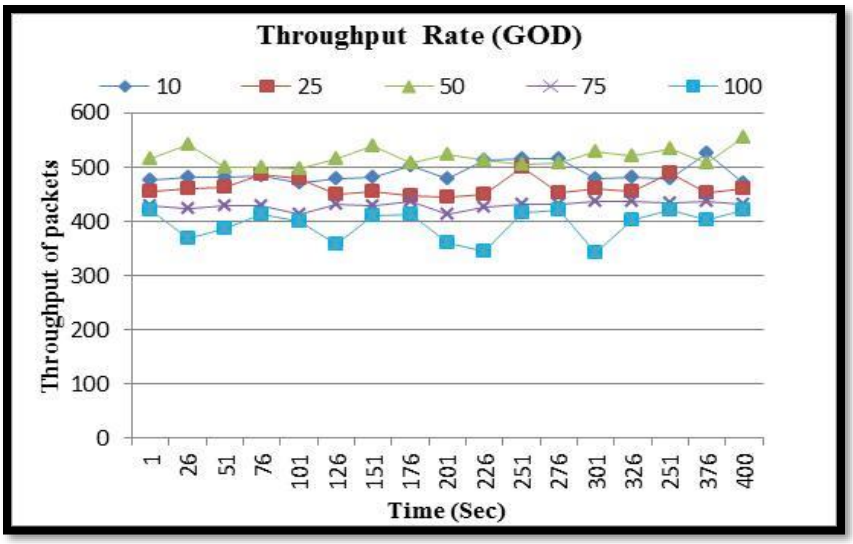

Figure 16. Throughput Rate using GOD Protocol

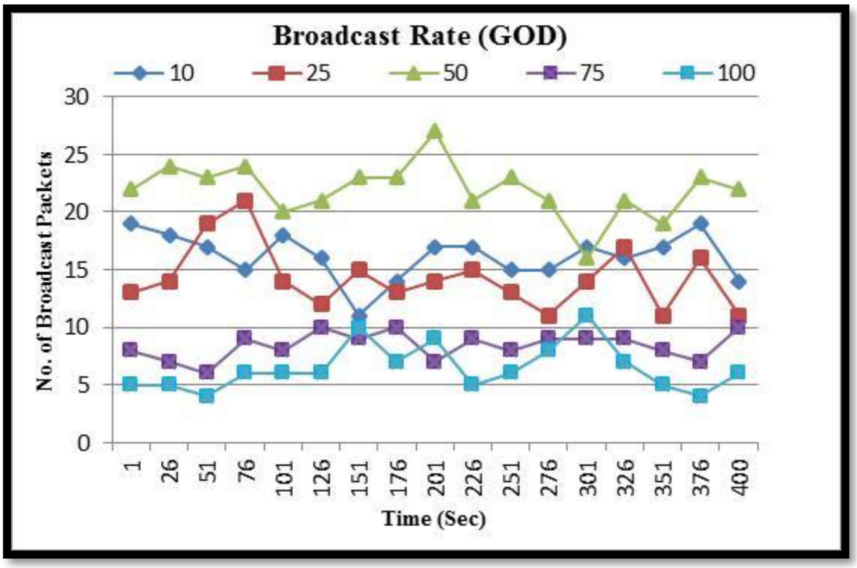

Figure 17. Broadcast Rate using GOD Protocol

The above graphs depict that performance of GOD is totally different from above protocols and it has been evaluated in Figures 14-17. The graphs reveal that when queue size is smaller, behavior of performance parameters is almost similar to that of above mentioned protocols but as queue size becomes 50 packets, the throughput rises swiftly. On further increasing the queue size, throughput rate again start decreasing due to the increase in number of collision and dropped packets. So for GOD optimum queue size is approximately 50 data packets. By comparing and analysing all the routing protocols it is concluded that hybrid routing protocol ADV gives best performance. Though it gives superior results at all queue sizes but optimum results are achieved at small queue size. Hence 10 packet queue size is selected as the optimum queue size for 802.11b MAC. More detailed values of performance parameters are tabulated in the following Table 2.

Table 2. Average Values of QoS Parameters in Various Routing Protocols

PERFORMANCE PARAMETERS OF ROUTING PROTOCOLS AT DIFFERENT QUEUE SIZES					
QOS PARAMETERS	QUEUE SIZE	AODV	ADV	DSDV	GOD
PACKET COLLISION RATE	10	25.168	19.121	93.224	141.271
	25	39.948	27.218	98.424	155.866
	50	61.523	54.379	127.729	62.291
	75	73.436	61.823	161.702	143.271
	100	81.034	74.890	165.357	148.253
PACKET DROP RATE	10	34.129	26.331	131.489	251.422
	25	46.316	38.379	154.390	256.879
	50	76.151	59.823	176.687	81.837
	75	89.739	76.382	264.241	185.037
	100	97.981	83.786	296.354	198.567
THROUGHPUT RATE	10	560.161	594.315	506.691	471.753
	25	558.104	561.743	510.310	454.873
	50	544.736	550.923	481.422	505.469
	75	429.479	512.959	402.432	431.765
	100	417.864	493.468	354.321	423.181
BROADCAST RATE	10	23.339	45.219	16.483	17.753
	25	21.908	37.291	17.240	14.761
	50	18.523	26.301	12.274	20.982
	75	11.977	22.878	11.285	7.452
	100	9.809	15.834	8.359	5.876

The above table explains the average values of QOS Parameters obtained at different queue sizes in four routing protocols namely AODV, ADV, GOD and DSDV. The average values of AODV, DSDV and ADV show identical behavior *i.e.*, with gradual increase in queue size the performance parameters follow the same pattern. More specifically, for these protocols with increase in queue size the performance is degrading and optimum results are shown at smaller queue sizes. Hence 10 packet queue size is chosen as the optimum queue size for aforementioned protocols whereas in GOD the results are comparatively different. The operation logic of GOD is that it manages all the movement patterns during simulations. In this algorithm it has been observed that as the queue size increases gradually the throughput of the system start deteriorating but as the queue size approaches to 50 packets, the throughput of the system rises abruptly and on further increasing the queue size, throughput rate is again dropped due to the increase Packet Collision Rate and Packet Drop Rate. So by comparing all the routing protocols at different queue sizes it is finalized that ADV routing protocol is most appropriate. Although it gives respectable results at all queue sizes but small queue size is more appropriate in terms of all QoS parameters. Hence 10 packet queue size is chosen as optimum for ADV Protocol.

5. Conclusion

In order to identify the optimum queue size for IEEE 802.11b MAC, the work has been done in this paper. The routing protocols such as AODV, DSDV, ADV and GOD have been used here to investigate the effect of varying Queue size in terms of important QOS parameters namely Packet Collision Rate, Packet Drop Rate, Throughput Rate and

Broadcast Rate. So optimum queue length is selected in such a way that higher throughput rate is achieved. Since greater throughput rate results in effective and efficient delivery of data packets to the destination. It has been evaluated through extensive simulations that optimum queue size for 802.11b standard for VANET comes out to be 50 packets for GOD and 10 packet size for AODV, ADV and DSDV routing protocols. Based on the performance of QOS parameters, ADV a Hybrid Routing Protocol is chosen as the most efficient routing protocol. Results produced here in this paper are of great significance for the researchers working in planning, development and design of VANET.

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References

[1] S. Zeadally, R. Hunt, Y. S. Chen, A. Irwin and A. Hassan, “Vehicular ad hoc networks (VANETS): status, results, and challenges”, Springer Science+Business Media, LLC, **(2010)**.

[2] S. Jinyuan, Z. Chi and F. Yuguang, “An ID-based framework achieving privacy and non-repudiation”, In Proceedings of IEEE vehicular ad hoc networks, military communications conference, **(2007)**, pp. 1-7.

[3] N. Balon, “Introduction to vehicular ad hoc networks and the broadcast storm problem”, http://www.csie.ntpu. edu.tw/~yschen/course/96-2/Wireless/papers/broadcast-5.pdf, **(2007)**.

[4] The GUI based User Manual for the NCTUns 6.0 Network Simulator.

[5] W. Chen, R. K. Guha, T. J. Kwon, J. Lee and Y. Y. Hsu, “A survey and challenges in routing and data dissemination in vehicular ad hoc networks”, Proceedings of IEEE International Conference on Vehicular Electronics and Safety, **(2008)**, pp. 328-333.

[6] K. Priya and J. Malhotra, “Optimisation of MAC Layer to mitigate the effect of increased Mobility in VANET”, communicated in Innovative Applications of Computational Intelligence on Power, Energy and Controls with their impact on Humanity (CIPECH 16), **(2016)**.

[7] A. Dana and A. Malekloo, “Performance comparison between Active and Passive Queue Management”, IJCSI International Journal of Computer Science Issues, vol. 7, no. 3, **(2010)**, pp. 682-686.

[8] Q. Zhao, Y. Zhu, C. Chen, H. Zhu and B. Li, “When 3G Meets VANET: 3GAssisted Data Delivery in VANETs”, Sensors Journal, IEEE, vol. 13, no. 10, **(2013)**, pp. 3575- 3584.

[9] S. Patel, P. Gupta and G. Singh, “Performance measure of drop tail and RED algorithm”, in Proceedings of 2nd International Conference on Electronic Computer Technology (ICECT), (**2010)**, pp. 35-38.

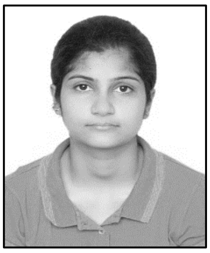
[10] M. Faezipour, M. Nourani, A. Saeed and S. Addepalli, “Progress and challenges in Intelligent Vehicle Area Networks”, Communications of the ACM, vol. 55, no. 2, **(2012)**, pp. 90-100.

[11] A. Shukla and S. Sharma, “Queue Length based Load Balancing Technique using with AOMDV Protocol in MANET”, International Journal of Scientific & Engineering Research, vol. 4, no. 10, **(2013)**, pp. 506-511.

[12] X. Liu, E. Chong and N. Shroff, “Opportunistic transmission scheduling with resource sharing constraints in wireless networks”, IEEE Journal on Selected areas in communications, vol. 19, no. 10, **(2001)**, pp. 2053-2064.

[13] A. Eryilmaz and R. Srikant, “Fair Resource Allocation in Wireless Networks using Queue Length based Scheduling and Congestion Control”, Proceedings of Annual Joint Conference of the IEEE Computer and Communications Societies, vol. 3, **(2005)**, pp. 1794-1803.

Authors



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His research interests are in the broad area of Pervasive Communication systems and Networks with emphasis on Statistical modeling of Fading Channels, Fading mitigation techniques, Optimization of High data rate Optical and wireless Communication Systems, Enhancement of QoS aware Wireless networks and Wireless Security. Dr. Malhotra has published and presented more than 170 technical papers in scientific journals and international conferences and authored 02 books. He is a life member of Indian Society for Technical Education (I.S.T.E.) and Editorial Board of many International Journals of repute.