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# Swarm Based Enhanced Hybrid Routing Protocol in VANETs

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***Abstract-Vehicular Ad-hoc Networks (VANETs) play main role in the design and development of the Intelligent Transportation Systems (ITS) who improves the road safety and transportation productivity. One of the most important challenges of this category of network are the timely, safely and reliable dissemination of messages between vehicular nodes to improve the road safety. Here in this paper PSO based hybrid routing protocol have been proposed. To demonstrate the effectiveness and the performance of this protocol, several metrics such as end to end delay, packet delivery ratio, and normalized overhead load are calculated. The results obtained better performance results with PSO based hybrid routing protocol in contrast to results obtained from traditional routing algorithms such as Ad hoc On-Demand Distance Vector (AODV) and Bio-inspired bee swarm protocol (HyBR).***

***Keywords:-Vehicular ad-hoc network, routing optimization, Bio-inspired computing, Bee swarm, Particle swarm optimization.***

## I. INTRODUCTION

VANET [1] isanew trendingtechnology integrating the abilities of the new generationwirelessnetworkskeen on vehicles. VANET firstly targets to offer the connectivitytomobileuserswhiletheyareonthe road continuously,thatenablesuserstolinkwithrestusersthroughthelatter'snetworks,andsecondly for theeffective wireless connection betweenvehicleswithoutaccesstoany fixedinfrastructure,which enables theITS.The features ofVANET are typically alike to the operation technology of a mobile adhoc network (MANET) in the sense that the self-organization, low bandwidth, and shared radio transmission conditions remains the same. However, the key operational impediment of VANET arises from the high speed and tentative mobility (in contrast to the MANET) of the mobile nodes (vehicles) along the paths. This fact indicates that the competent design of routing protocol [2], [3] requires improving the MANET architecture to efficiently accommodate the fast mobility of the VANET nodes. This issue has introduced numerous research challenges to the design of a suitable routing protocol. The foremost objective of routing protocols is to attain short communication time while using the least amount of network resources. Many routing protocols have been designed for MANETs, of which few can be directly implemented to VANETs.

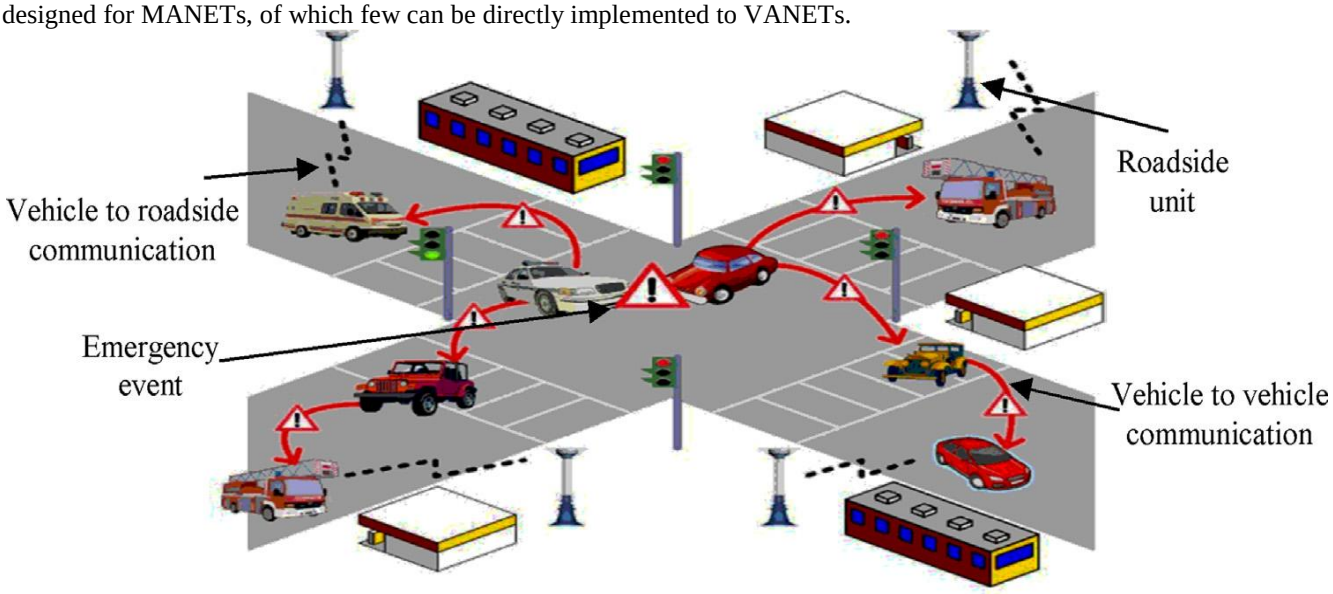


Figure 1: Vehicular Ad-Hoc Networks Architecture [15]

The performance of VANETs is affected by the following factors: fast- moving vehicles, active information transfer, and the associated high speed of mobile nodes, which differ from those of MANETs. Consequently, identifying and

 

administering routes are a demanding task for VANETs. This fact has guaranteed a variety of research challenges to the design of a suitable routing protocol.The main goal of VANET is to deliver road safety measures which tell the information about vehicle's current speed, location coordinates that are passed with or without the arrangement of the infrastructure communication. The Vehicle to Vehicle communication methodology is mostly appropriate for short range vehicular networks. It is reliable and also provides real time security. It does not require any roadside infrastructure. Vehicle to Vehicle does not have any problem of Vehicle Shadowing in which a smaller vehicle is shadowed by a larger vehicle stopping it to communicate with the Roadside infrastructure. Vehicle to Infrastructure is the solution to longer-range vehicular networks. It also makes usage of already existing network infrastructure such as wireless access points. Communications between vehicles and RSUs (road side unit) are supported by the Vehicle-to- Infrastructure (V2I) protocol and the Vehicle-to-Roadside (V2R) protocol. We need to develop and apply efficient routing algorithms which allow all the packets to be routed from the sender to the receiver via a set of intermediate nodes with a high level of Quality of Service (QoS) [4], [5] to ensure the timely, safely and reliable delivery of information and multimedia data, and ITS applications [6]. QoS, in this framework, means sending data among nodes with a minimum end-to-end delay and routing overheads. Additionally, QoS also ensures the successful delivery of the maximum number of transmitted messages (i.e., with a minimum number of dropped packets) where the network bandwidth is optimally used. Vanet consists of two main transmission modes of routing: the first one is called unicast in which data packets are sent to one destination. The second mode is multicast, which aims to transmit data packets to multiple destinations at once. Now days, a new area, called swarm based routing, has developed which take biology and nature as a source of inspiration, and mimics the laws and dynamics of natural species. Swarm based routing has received a lot of interest lately because of its high performance results and outstanding capabilities to solve theoretical and experimental problems, as well as its high suitability for various applications [7], [8]. When communication end-points are not within their respective radio transmission range, how is it possible to establish communication between two vehicles or between a vehicle and a roadside base station which satisfies the constraints imposed by road safety applications? To address this challenge, we propose a new swarm based routing protocol called the Hybrid swarm Routing protocol for VANET. It is a hybrid protocol that combines geographic routing based on Global Positioning System (GPS) to establish routes, with topology-based routing which discovers paths using network topology data.

## II. RELATED WORK

Now days many routing protocols are being developed which are categorized into two types. One is topology based and another is Geography based. Topology based routing protocols uses the network topology data for the connection between the vehicles and the Geography based routing protocols uses GPS (Global Positioning System) facilities to route the packets.

### *1. Topology Based Routing Protocol: -*

Topology based routing protocols uses the link's informationin the network through which it send the data packets from source to the destination. Topology based routing methodologies can be further classified into proactive (table-driven protocols) and reactive (ondemand protocols) routing.

A) Proactive (table-driven protocols):- Proactive routing protocols are basically based on shortest path algorithms. These protocols records of all connected nodes in the form of tables as these protocols are table based. Whenever there is any change in the network topology, each node updates its routing table accordingly.

B) Reactive (On Demand protocols):- Reactive routing protocols are called as the demand routing because they starts route discovery whenever a node have to communicate with another node so as to reduce the network traffic.

### *2. Geography Based Routing Protocol: -*

Geography-based routing protocols have also been implied to VANET. Geography based routing protocols are also known as position-based routing protocols where the node positions are used to route data among vehicles. The packets are routed to the destination without knowing the network topology or any prior route discovery this feature of this protocol is known as robust property.Comparatively, the source also determines its own position in addition to the position of the destination.

## III. METHODOLOGY

A Hybrid bio-inspired bee swarm routing protocol (HyBR- hybrid of bees life algorithm and genetic algorithm)[14] for safety applications in Vehicular Ad hoc networks (VANETs)is integrated with particle swarm optimization for improving the routing efficiency of HyBR. Optimization solves VANET routing issues. The methods involved are as follows:

### *1. Bees Life Algorithm (BLA)*

Numerous computational snags have been resolved by new tactics inspired by Bees' behaviors. The general methodology is called Bees Life Algorithm in which the two major activities of bees have been used: food foraging and reproduction.

- Food foraging behavior is noted when bees explores the new nest sites or while food source foraging. To do this, some bees (called scouts) navigate and explore the area to find a food source. If the food is found, they come at the dance floor in the beehive to share their findings with the other nest mates vialanguage of dance which can be round or waggle related to the distance of the food source found. Some other bees (called foragers) are recruited to exploit this discovery.

 

- Reproductive behavior is assured by the queen whichmates with severaldrones in a mating-flight. After three days,the queen lays its eggs. The unfertilized egg will give rise to adrone, whereas, the fertilized egg originate to worker or queen depending on the food quality that was given to the larvae [9].

***2. Genetic Algorithm (GA):-***

Genetic algorithm was originally developed by Bremermann in 1958 and promoted in the 1970s by John Holland. Genetic algorithms are the processes that have the possibility to find an estimated solution to an optimization problem grounded on the concept of natural selection. The ultimate beliefs of Genetic algorithms are to find the solutions perhaps the finest known as initial population. Then other transformations are performed for improving the solution after a number of iterations. The execution of a GA reproduces biological processes, by performing mutation and crossing of individuals of the population.

Mutation: A minor alteration of a person.

Crossing: Crossing is a process of the mixture of two individuals, which produce a new individual.

Selection: As the Genetic algorithms are grounded on the principle of natural evolution, an evaluation stage of the individuals by mutation or crossover is required to continue with the selection of the best elements of the population.

***3. Particle Swarm Optimization (PSO):-***

PSO [13] is a method to explore a given problem's search space to localize settings or parameters to maximize a particular objective [10]. Optimization permits one to find a function or process's maximum/minimum value. In optimization tasks, called constrained optimization tasks, candidate solution elements are subject to some constraints (like being greater or lesser than zero). PSO is a computational intelligence-based technique mostly unaffected by a problem's size and nonlinearity and converges to an optimal solution in problems where analytical methods do not converge. It can be applied to various optimization problems in power systems. Evolution of PSO is possible by incorporating methods already tested in other evolutionary computation techniques.

- ***Advantages Of PSO Over Other Optimization Techniques:***

1) PSO is easier to implement as it has fewer parameters to adjust.

2) In PSO, all particles remember their previous best value and also the neighborhood best; hence, it has better memory capability than GA.

3) PSO is more efficient in maintaining swarm diversity [11] (similar to ideal social interaction in a community) as all particles use information related to the most successful particle to improve themselves, while in GA, worst solutions are discarded and only good ones saved; so, population revolves around a subset of best individuals in GA.

## IV. SIMULATION SETUP

The purposed work have been evaluated for the performance of protocols using Network Simulator (ns2) [12] which is a discrete event network simulator based on C++ and OTcl script. The plots are the result of simulation of each protocol for different number of nodes. Table I summarizes the parameters used by the simulator to create the VANET simulation environment.We simulated the hybrid routing protocol on the Ubuntu 9.10 Linux Operating System using network simulator NS2 in its version 2.34. The simulated network consisted of 20, 50, 100 mobile nodes, that acts as the vehicles. The proposed simulation time is for 100 seconds in a 500 x 500 square meter area. Various schemas have been created to test the performance parameters.

Table I: Simulation Parameters

| Parameters | Values |
|---|---|
| Channel | Wireless |
| Propagation Model | Two Ray Ground |
| MAC | IEEE 802.11 |
| Area | 500*500 |
| No. of Nodes | 20,50,100 |
| Simulation time | 100sec |
| Protocols | AODV, HyBR, PSO based hybrid protocol. |

## V. EXPERIMENTAL RESULTS AND DISSCUSSION

The proposed work is simulated and tested for 20, 50, 100 node to evaluate the performance parameters. The nodes have random trajectory and are spread in a 500 m by 500 m area.Simulations are run for 100 sec. The proposed work will be evaluated for the following road safety metrics:-

- **Average end-to-end delay**: - The average end-to end delay is the average time taken between the generation of a packet by the source node and the time when this packet is received at the destination which includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation.

 

Figure 2, 3, 4 show the average end to end delay output graphs simulated for 20 nodes:-

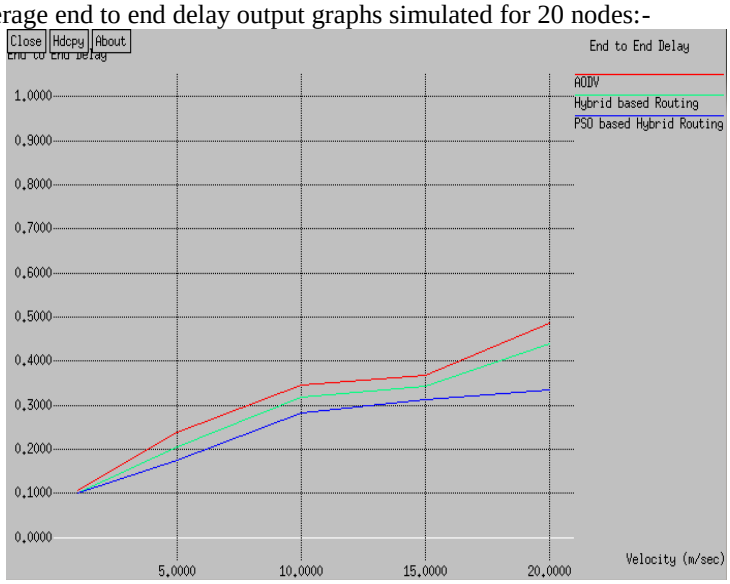


Figure 2: End to End Delay for 20 nodes

Here it is shown that the delay keeps on decreasing as we use the proposed method for the routing. Three protocols have been tested with the same simulation environment i.e. AODV, HyBR and HyBR integrated with PSO.

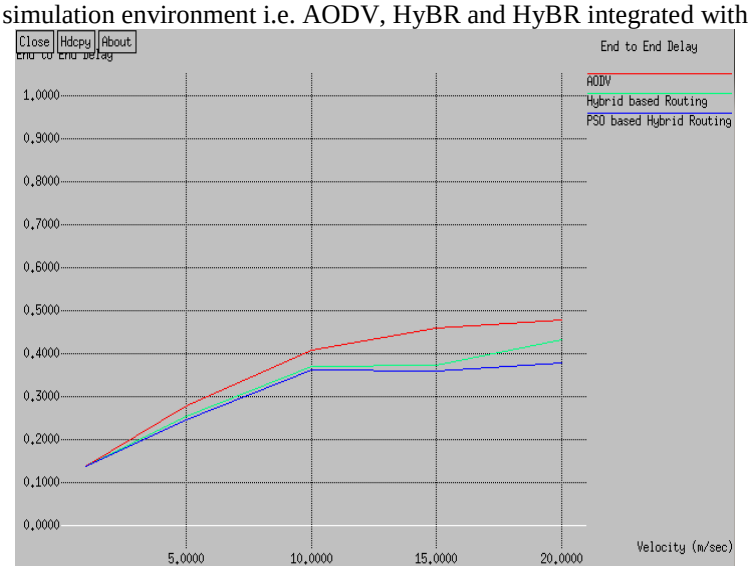


Figure 3: End to End Delay for 50 nodes

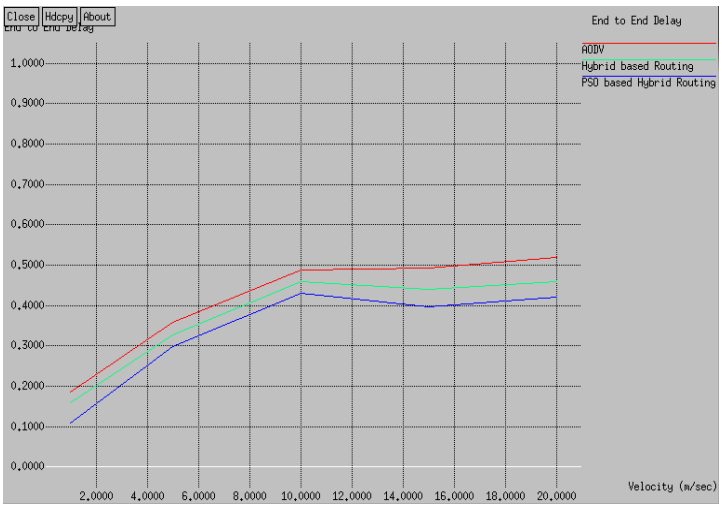


Figure 4: End to End Delay for 100 nodes

- **Packet delivery ratio**: - The Packet Delivery Ratio (PDR) metric is the number of packets successfully received by the destination node to the number of packets that was transmitted by the source nodes.

 

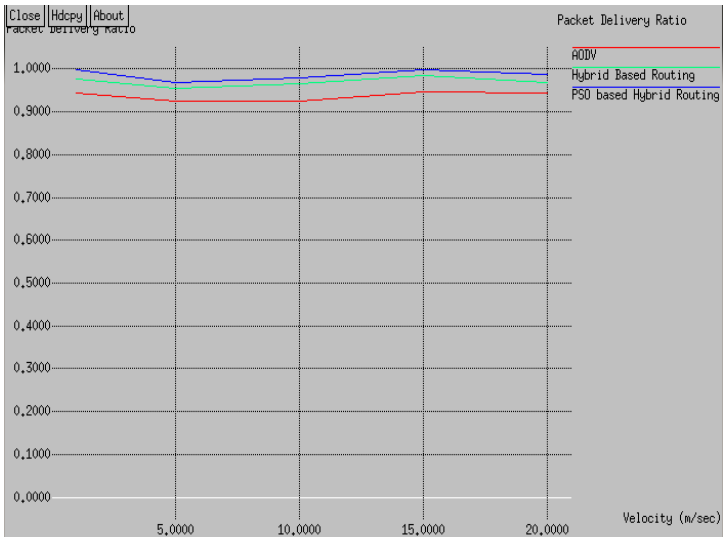


Figure 5: Packet Delivery Ratio for 20 nodes

In figure 5, 6, 7; the graphs for Packet Delivery Ration has been shown. All three protocols are test with same simulation environment. PSO based hybrid routing have the highest packet delivery ratio as compared to AODV and HyBR.

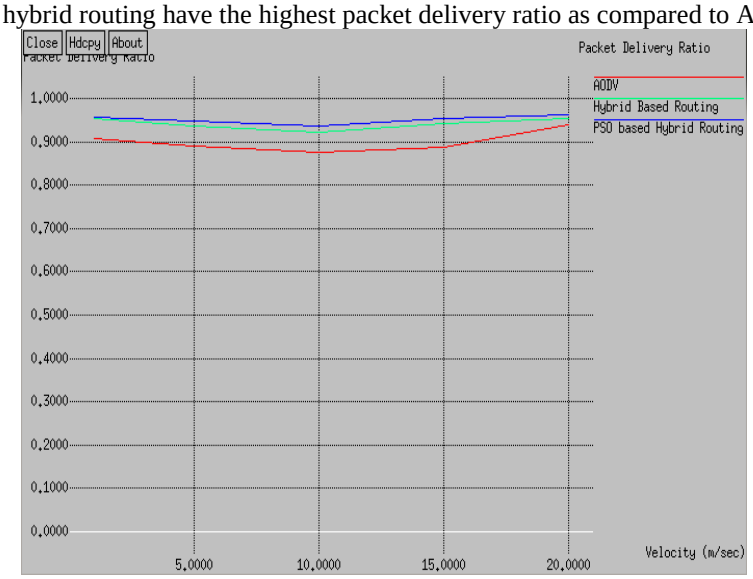


Figure 6: Packet Delivery Ratio for 50 nodes

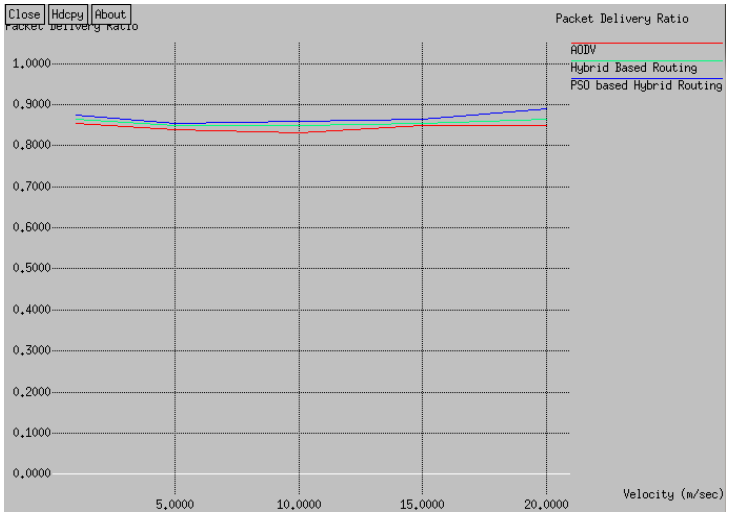


Figure 7: Packet Delivery Ratio for 100 nodes

- **Normalized Overhead Load**: -The Normalized Overhead Load (NOL) represents the total number of routing packets divided by total number of data packets delivered. It is used to indicate the extra bandwidthconsumed by the overhead to deliver data traffic

 

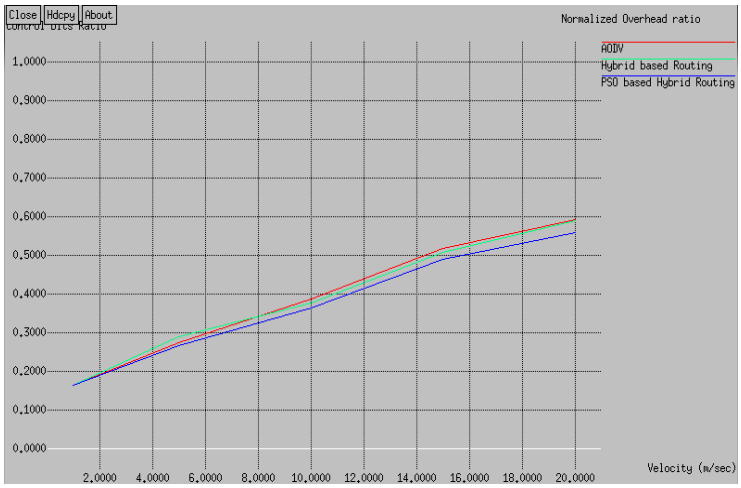


Figure 8: Normalized Overhead Ratio for 20 nodes

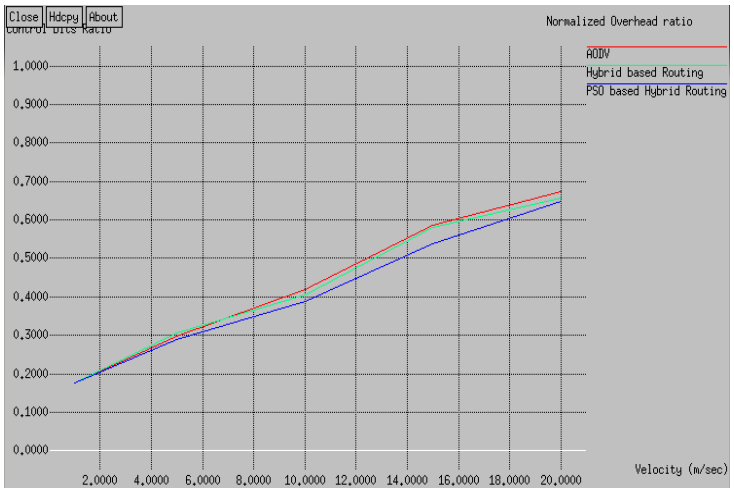


Figure 9: Normalized Overhead Ratio for 50 nodes

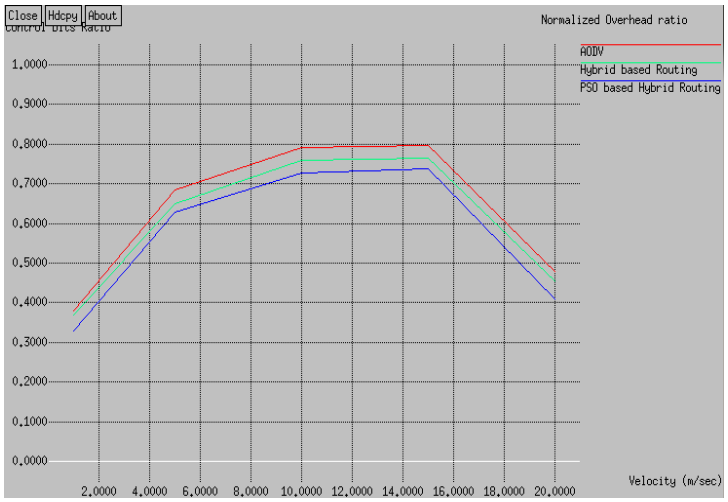


Figure 10: Normalized Overhead Ratio for 100 nodes

Here in figure 8, 9, 10; the graphs for Normalized overhead Ratio is shown, which depicts that the overhead is decreasing in the PSO based hybrid routing protocol as compared to AODV and HyBR.

## VI. CONCLUSION

In this paper, a new PSO based hybrid routing protocol have been proposed for VANETs. The proposed routing protocol is protocol designed by integrating PSO (Particle Swarm optimization) with the Bio-inspired Bee swarm routing protocol known as HyBR. The proposed system is simulated and tested on NS2 simulator. The system is tested for 20, 50 and 100 nodes. The results obtained from simulation shows that the new PSO based hybrid routing protocol shows better performance in terms of the safety parameters i.e. End to End Delay, Packet Delivery Ratio and Normalized Overhead load.

 

**REFERENCES**

[1] H. Hartenstein and K. Laberteaux, *VANET Vehicular Applications and Inter-Networking Technologies*. Upper Saddle River, NJ: Wiley,Dec. 2009, ser. Intelligent Transport Systems.

[2] T. Taleb, E. Sakhaee, A. Jamalipour, K. Hashimoto, N. Kato, and Y. Nemoto, "A stable routing protocol to support ITS services in VANET networks," *IEEE Trans. Veh. Technol.*, vol. 56, no. 6, pp. 3337–3347, Nov. 2007.

[3] F. Li and Y. Wang, "Routing in vehicular ad hoc networks: A survey," *IEEE Veh. Technol. Mag.*, vol. 2, no. 2, pp. 12–22, Jun. 2007. [Online]. Available: http://dx.doi.org/10.1109/MVT.2007.912927

[4] S. Bitam, and A. Mellouk (2011), "QoS Swarm bee routing protocol for vehicular ad hoc networks," *Proc.IEEE ICC'11*, Kyoto, Japan, pp. 1-5.

[5] A. Mellouk, S. Hoceïni, and S. Zeadally (2009), "Design and performance analysis of an inductive QoS routing algorithm," in *Comput. Commun*, vol. 32, no. 12, pp. 1371-1376.

[6] Y. W. Lin, Y. S. Chen, and S. L. Lee (2010), "Routing protocols in vehicular ad hoc networks: a survey and future perspectives," in *J. Inform. Sci. Eng.*, vol. 26, no. 3.

[7] F. Neumann, and C. Witt (2012), "Bio-inspired computation in combinatorial optimization: algorithms and their computational complexity," *Proc. ACM Int.Conf. Genetic Evol. Computation*, pp. 1035-1058.

[8] J. Kennedy, and R. C. Eberhart (1995), "Particle swarm optimization," *Proc. IEEE Int. Conf. NeuralNetwork*, pp. 1942–1948.

[9] S. Bitam, M. Batouche and E-G.Talbi "A survey on bee colony algorithms," in *Proc. IEEE IPDPS, NIDISC workshop*, Atlanta, GA, USA, pp. 1-8.

[10] Blondin, J. (2009). Particle swarm optimization: A tutorial. from site: http://cs. Armstrong. Edu/saad/csci8100/pso tutorial.Pdf.

[11] Del Valle, Y., Venayaga moorthy, G. K., Mohagheghi, S., Hernandez, J. C., & Harley, R. G. (2008). Particle swarm optimization: basic concepts, variants and applications in power systems. Evolutionary Computation, IEEE Transactions on, 12(2), 171-195.

[12] The Network Simulator - ns-2. http://www.isi.edu/nsnam/ns.

[13] J. Kennedy, and R. C. Eberhart (1995), "Particle swarm optimization," *Proc. IEEE Int. Conf. NeuralNetwork*, pp. 1942–1948.

[14] Salim Bitam, Abdelhamid Mellouk , Sherali Zeadally (2013 Elsevier) HyBR: A Hybrid Bio-inspired Bee swarm Routing protocol for safety applications in Vehicular Ad hoc Networks (VANETs),Journal of Systems Architecture 59 (2013) 953–967.

[11] BaraaT.Sharef, RaedA.Alsaqour ,MahamodIsmail , Vehicular communication ad hoc routing protocols: A survey(2014), Journal of Network and Computer Applications40(2014) 363–396.

 