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Performance Enhancement in VANET using Balance Vector Protocol and Nature Swarm Algorithm

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***Abstract*—**VANET is a rapid development of wireless communication technologies; give now the design of this technology in vehicles, in order to enhance intelligent transport systems by great advantages that could be derived from this technology with the objective of enhance the variability of traffic and improve RS (Road Safety), this kind of network gives communication between vehicles or between vehicles and roadside access points. In existing work, problem formulation defined security in VANET plays a vital role. VANET normally refers to a wireless network of mixed sensors or other computing devices that are deployed in vehicles. This type of network enables constant observing and sharing of road conditions and status of the transportation systems. AODV is the most normally used topology based routing procedure for VANET. Using of broadcast packets in the AODV route discovery phase caused it is tremendously susceptible against DoS and DDoS flooding attacks. In proposed work, a method using ontologies and vehicle data traffic management or information to ensure the data transmission of packets as soon as possible and in the most reliable way. Simulation tool used MATLAB 2016a to evaluate the performance metrics like as a packet delivery rate, throughput, End to End Delay and Overhead. In research work, proposed in B-AODV and PSOA algorithm, to improve the communication range, minimum overhead and packet delivery rate.

***Keywords*—**VANET (Vehicular Ad-Hoc Networks), B-AODV (Balanced Ad-Hoc On Demand Distance Vector), DDoS (Distributed Denial of Service) and PSOA (Particle Swarm Optimization Algorithm).

I. INTRODUCTION

With the internet becoming an increasing important part of our lives, the vision of wireless technologies enabled city is becoming nearer to reality. One of the interferences with that vision, however, is the high router need, for wireless internet to extend a city, 1000s of wireless routers must be strategically placed to ensure constant coverage. A network, which interconnects the vehicles on the road a Vehicular Ad-Hoc Network (VANET). VANET is a reorganization obtained by moving autos to make Mobile systems. Vehicles in VANET are Dedicated short range correspondence (DRSC) prepared [1]. Each vehicle will turn into a hub in VANET and get the radio messages through the network. VANET changes over every auto into remote hubs and make an extensive variety of systems. VANETs have a place with the remote specially appointed system. VANET otherwise called Inter Vehicular Communications (IVC). The motivation behind VANETs is to expand street wellbeing with remote correspondence, because of which VANETs require secure directing conventions. VANET impacts the change of ITS to give solace and well being to clients [2].

VANET implies that nodes in VANETs are base stations or Vehicles. Both public (like buses, police cars, ambulance, etc.) and private (individuals, private company cars etc.) vehicles can be included. Vehicles can communicate with roadside units as well vehicles itself interchangeably.

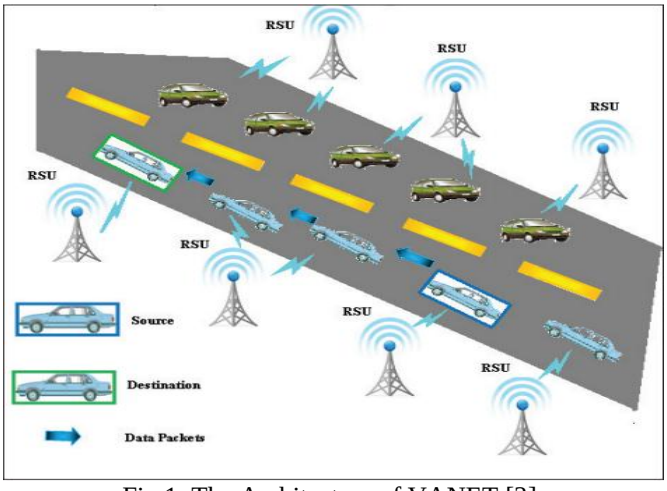

Fig.1. The Architecture of VANET [3]

A. *Types of VANET*

1) ***Inter-Vehicle Communication:*** In such configuration Multi-hop multicast/broadcast is used for the passage of traffic related data to the groups of users or receivers
2) ***Vehicle–to-Roadside Communication:*** A single hop broadcast is represented in this configuration in which

broadcast message was sent by the roadside unit to all equipped vehicles in the nearby region.

3) ***Routing Based Communication:*** This configuration uses multi-hop unicast that includes messages which are spread in MH (multi-hop) style until to the vehicle reached to the desired information or data.

B. Characteristics of VANET

The VANETs are application of MANET, with its own set of distinguishing properties can be described as:

1) ***Higher Mobility:*** The nodes of VANET are moving relatively at higher speed caused by the VANET's environment become harder to predict and highly dynamic.
2) ***Restricted Mobility Patterns:*** Unlike MANETs, VANET's movement of nodes governed by certain access authorized rules that are less predictable in the short run.
3) ***Network Topology:*** VANET's high speed characterization of nodes leads to continuous change in topology. Due to which high communication overhead was introduced to exchange new topology data.
4) ***No Power Constraints:*** Battery equipped vehicles have an infinite supply of power for both communication and computation resources.
5) ***Localization of vehicles:*** The vehicles in VANET used a GPS system to identify locations with accuracy and gather information from roadside units and other vehicles.
6) ***Abundant Networks Nodes:*** Unlike MANETs, VANETs has a huge network as designed for wireless environments. Data exchange via wireless.
7) ***Hard Delay Constraints:*** The focus is on VANET to allocate more safety messages which are prioritized and delivered on time [4].

C. VANET Applications

Several implementations of VANET depend on car to infrastructure along with car to car traffic or car to home applications as well as routing based applications are widely classified as Safety oriented, Convenience, commercial oriented and productive applications. Different implementations are: [5]

1) ***Real Time Traffic:*** Genuine, real time traffic information saved at RSUs and available for all automobiles whenever required. It plays a significant role in solving problems like: congestions, emergency, etc.
2) ***Co-operative Message Transfer:*** Slow or non-moving vehicles will transfer messages to assist other vehicles. Latency and reliability are key concern and automate things to avoid situations like accidents, etc.
3) ***Internet Access:*** Automobiles can access network via RSU, in case those RSUs are performing as routers.
4) ***Digital Map Downloading:*** Drivers can download area maps as per requirement to travel new place for guidance. Portable maps can also be used.
5) ***Route Diversion:*** Planning trip or route can be altered as per situations or in congestion.
6) ***Parking Availability:*** Notification related to availability of parking area assists to find the available space in specific regions.
7) ***Time Utilization:*** Reading mails or doing work while in a jam packed areas, one can utilize the free time to do something productive.
8) ***Fuel Saving:*** Stopping the ignition while waiting on the toll booths or at traffic lights can save around 3% of fuel.

The research work is partitioned into different section. The first section is about the basic information about network and specifically the detailed description of vehicular ad-hoc network (VANET). The second section contains the survey of previously used techniques for vanity. Third section describes the different routing protocols, and the fourth section is about the proposed techniques as B-AODV and PSOA. The further section comprises the result discussion. At the end the conclusion and future scope of the present research work is given.

II. LITERATURE SURVEY

Kaur, G. et al., (2017) [6] described a way to detect and isolate several kinds of attacks, but the focus was on the detection of jamming attacks in the vehicular ad-hoc network. A vehicular ad-hoc network was a network which included the mobile nodes and these nodes were communicated through wireless signals. While communicating, the malicious nodes were linked to the network and activate several different categories of active and passive attacks in the nodes. It creates the extreme flood of nodes in the network that reduced the availability of resources and hides the data packets. For the detection of jamming attack, a technique was planned as threshold technique that sends a threshold value to the network to lessen the effect of jamming. It was demonstrated that, it increased the performance of the network in the terms of higher throughput, less delay and reduced losses of packets. **Feng, X., et al., (2017) [7]** proffered an approach which worked effectively against the multi-source Sybil attacks in VANETs. Generally, VANETs were pivotal in the intelligent transportation systems. The Sybil attack affects the criteria of the traffic system by allotting some unnecessary false messages with the different identities. Later, it generates the traffic jams and therefore, the chances of accidents were raised rapidly. The detection and defending of Sybil attack was harder. In this research work, the planned approach was EBRS (An Event based Reputation System). In this system, the powerful reputations and trusted factors were assigned to each event to alleviate the distributed false messages. It had the tendency to identify

the identities and stolen data from the general process of communication in a network. Each event in the network must contain the unique reputation and trusted factor which helped to differentiate the false messages and identities. **Mittal, S. et al., (2017) [8]** demonstrated the routing protocols in the vehicular ad-hoc network through some specific alterations in the route discovery mechanism. The collection of nodes was interconnected to every node without accessing any power was called as an ad-hoc network. For the communication modes in the network, routing protocols were utilized and worked well. AODV (Ad-hoc on Demand Distance Vector) was an effective protocol in vehicular ad-hoc network that had the properties as more versatility, fast processing speed. In the current research, the fundamental approaches of AODV based were briefly described. Firstly, the approach improved the message as HELLO and taking a control over the message by sharing information among multiple nodes. As a result, the congestion from the network was degraded. At the same time, other approaches were making a different route option to send the data packets in a short while. Consequently, the performance of the network was improved using a proposed strategy I-AODV (Improvising AODV). **Ashtaiwi, A., et al., (2017) [9]** explained the narrative of position based routing in vehicular ad-hoc network (VANET) on the basis of their performance. The vehicular ad-hoc network was a category of the mobile network and reliant on the principles of MANET (Mobile ad-hoc networks) the only difference was in VANET, the nodes are moving vehicles. The applications of VANET are dependent upon the robustness and the effectiveness of the routing protocols. In the VANET, there were countless routing protocols were assists, but the best one was considered the position based routing. To get the desired results, the performance of two positions based routing was compared. The first one was GPSR (Greedy Perimeter Stateless Routing) and GPCR (Greedy Perimeter Coordinator Routing). It was proven through the simulation tool NS2 that both routing protocols were given moderate performance under the higher vehicle speed. But in some situations, GPSR performed well as compared to GPCR. **Sharma, A. K., et al., (2016) [10]** proposed a prevention strategy due to the occurrence of a Sybil attack on the vehicular ad-hoc network. The wireless technologies were utilized in every sector because of the vast applications. Although there were some challenges that present in the network and required to be expelled as soon as possible, Sybil attack was one of them. The communication of nodes played out an important role in the safety and security in VANET (Vehicular Ad-hoc Network). Subsequently, the security was becoming a crucial phase in the designing of VANET architecture, and several kinds of threats occurred, such as Sybil, jamming, eavesdropping that degraded the performance of the current network. To eject the effects of Sybil attack, a system was designed which included a powerful certificate generation approach to take control over the Sybil attack and the closest information in the detection of malicious nodes.

III. ROUTING PROTOCOLS

Routing protocols are designed to discover the communication track in between the transmitter and receiver. These are necessary and play a crucial role in the performance of VANET. Routing protocols are the standards to authorize the nodes to decide a manner in which packet is transmitted between the devices in VANET. Several properties are expected from routing protocols are:

1) It should be dispersed in a way to maximize the authenticity.
2) It must be sketched after examining the one way links because it improves the performance.
3) It should be power efficient because laptops and PDAs have limited battery source.
4) The Radio network is vulnerable to attacks; therefore security measures are also necessary.

The highly dynamic topology designs highly effective routing protocols for vehicular ad-hoc networks which are complicated searching task. The categories of VANET routing protocols are shown in Fig. 2.

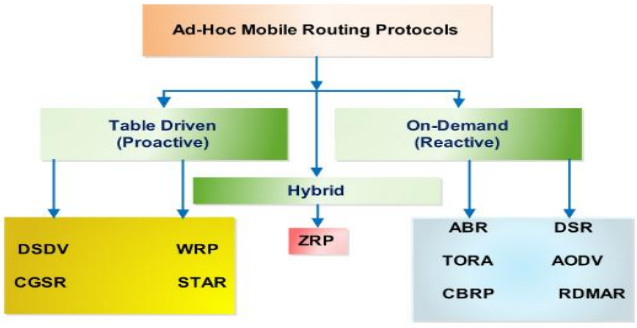

Fig.2. Different categories of VANET routing protocol [11]

A. Proactive Routing

Proactive routing conventions are for the most part in view of shortest way calculations. The measurements of associated hubs are kept in a forbidden frame on the grounds that these conventions are table based and these tables are imparted to their neighbors.

1) ***Fisheye State Routing:*** FSR [12] is a proactive or table driven directing convention where the data of each hub gather from the neighboring hubs. At that point compute the string table. FSR is an interface state directing and a change of Global State Routing based.

B. On Demand Routing

On Demand / Reactive routing protocol starts route discovery when communication with another node is required to reduce traffic on networks

1) ***AODV:*** Specially appointed On Demand Distance Vector convention [13] builds up a way while parcel exchange. It has the capacity of unicast and multicast steering. It utilizes a goal succession number which makes it not quite the same as other on request steering conventions.
2) ***Geographic Position based Routing Protocols:*** Geographic directing is a steering that every hub knows ITS own and neighbor's hub geographic position by position deciding administrations like GPS. It doesn't keep up any routing table or trade any connection state data with neighbor hubs.
3) ***VADD:*** Vehicle-Assisted Data Delivery [14] depends on the idea of convey and forward approach by utilizing predicable vehicle portability. Among proposed VAAD conventions H-VAAD demonstrates better execution.
4) ***GPSR:*** GPSR (Greedy Perimeter Stateless Routing) [15] chooses a hub which is nearest to the last destination by utilizing reference point. It uses sending estimation in the event that it neglects to utilized edge, sending to choose a hub by means of parcel exchange.
5) ***GPCR (Greedy Perimeter Coordinator Routing):*** This is a position-based directing tradition that uses unquenchable include to forward package perspective of pre-picked path composed to oversee troubles of city circumstances. No worldwide or outside data like static guide do not require in Greedy Perimeter Coordinator Routing [16].

C. *Cluster Based Routing*

Cluster based directing is favored in bunches. A social event of centers recognizes themselves to be a bit of a bundle and a center point is appointed as gathering head will impart the package to gather. Extraordinary flexibility can be obliged extensive frameworks yet organize deferrals and overhead are caused while surrounding bunches in significantly convenient VANET. Different Clusters based directing conventions are COIN and LORA_CBF [12].

D. Broadcast Routing

Broadcasting coordinating is once in a while used as a field of VANET for sharing, development, atmosphere and emergency, road conditions among vehicles and passing on advertisements and presentations. The different Broadcast directing conventions are BROADCOMM, UMB, VTRADE, and DV-CAST.

E. *Geo Cast Routing*

Geo cast, directing is fundamentally an area based multicast steering. The reason for this approach is to convey parcels from source hub to every other hub inside a predetermined geological locale (Zone of Relevance ZOR). In Geo cast coordinating vehicles outside the ZOR are not advised to avoid silly rushed reacting. Different Geo cast, directing conventions is IVG, DG-CASTOR and DRG.

In Table 1 RP (Routing Protocols), HS (Hierarchical Structure), SN (Simulator Network)

TABLE 1. Routing Protocol Comparison in Vehicular Ad-Hoc Network [5]

Number of RP	Type	Position	HS	SN	Models
AODV(On Demand Distance Vector)	Uni-cast	-	N	-	-
DSR Protocol	Uni-cast	-	N	-	-
PR-AODV	Uni-cast	Selected route	N	NS-2	Highway model
AODV-BIS	Uni-cast	Forward Route Request	N	-	-
A-STAR Protocol	Uni-cast	Forward packets	N	NS-2	Grid-city Model
COIN Protocol	Uni-cast	Formation of clusters	Y	Own	Real-Highway Model
LORA _CBF	Uni-cast	Forward packets	Y	OP-NET	Simple circle /square road
Flooding	Broad-cast	No	N	-	-
BROAD-COMM	Broad-cast	Cell formation	Y	Own	Simple-Highway Model
MSG DIS Protocol	Geo-cast	Forward packets	N	Own	Simple-Highway Model

IV. PROPOSED TECHNIQUES

In the present research work, the used techniques are B-AODV and PSOA. The description is given below-

A. B-AODV Protocol (Balanced Ad-hoc on demand Distance Vector) Routing protocol

B-AODV: Balanced Ad-hoc on demand Distance Vector routing Protocol based on Load Balance. Its theory is as the same of the standard AODV, the difference is the usage of delay forwarding technology mentioned in the fourth section in forwarding packets. When a source node wants to transmit data to the destination node, first it checks whether there is any existing valid path in the routing table. If it exists, the node uses that path; otherwise, it sends RREQ to its neighbor nodes. When a node (Either destination or intermediate) receives RREQ, it ensures that the received RREQ is not a duplicate RREQ, in order to prevent looping paths. If the neighbor node is the destination, it sends RREP. Otherwise, it waits for a delay and sends a new RREQ to all their neighbor nodes to find the destination. When the

destination gets the first RREQ, it waits for simulation time and collects all other RREQ coming in this interval. After simulation time, it calls the optimization function to determine the best path to select and send RREP. It also stores some other relatively inferior paths as backup paths, which may be used if there is some network failure [17].

B. PSO (Particle Swarm Optimization) Algorithm

PSO considered as an evolutionary computation approach. The process of PSO is fully dependent upon the population search algorithm. The concepts of particles are generated by the use of random solutions. It further supports to the velocity of particles that are usually arranged as per the historical behavior or nature. Kennedy and Ebehart invented the optimization approach of particle swarm algorithm in mid of 1990's. The velocity particles involved three fundamental sub-categories as social part, cognitive part and eventually the momentum part. The balance between these parts is trained to obtain both global and local searching capacities [18]. At each time step it altered the velocity of particle and moves each particle along with its PBEST and GBEST locations [19].

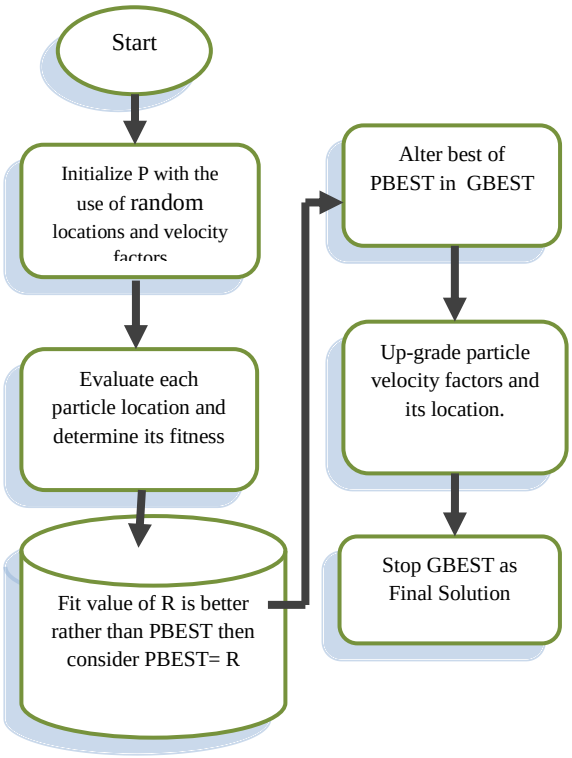

Fig.3.Particle Swarm Optimization Flowchart [19]

PSO does not require any kind of selection operator as compared to the genetic algorithm. Entire particles are saved in the form of members of a population of a run. According to researchers, the run is all about the number of evolutionary techniques that consists priority to stop. Later, it is obtained from assigning velocity of different particles. Other operators, as crossover, mutation and evaluation of fitness values do not necessarily.

This is a basic code for PSO that updates the particles according to their velocity factors and position. The code is based on the while loop.

Particle Swarm Optimization

Start
T = 0;
R(T); // initialize particles R along with T (time);
Determine R (T);
While
Stop criteria // not satisfied.
Start Again
T = T+1;
Update wts;
Choose PBEST for every particle
Choose GBEST from R (T-1);
 	
Determine velocity of each R
R (T);
Upgrade R(T);
Determine Particle R(T);
Stop
End

1) Advantages of PSO

There are numerous of advantages which are described as follows -

a) PSO can be utilized for MSA (maritime surveillance applications).
b) In wireless sensor networks, it played out a pivotal role in energy aware clustering method, optimal development, node localization and eventually in aggregation of data.
c) Implementation of PSO is easy to understand and to perform.
d) PSO has more efficiency toward computational problems.
e) Parameters in PSO adjusted according to the requirement.
f) Low variations of particles in almost every application.
g) PSO process is extremely robust.
h) Search larger spaces.

V. RESULT DISCUSSION

In this section the details of the simulation results considered for this study.

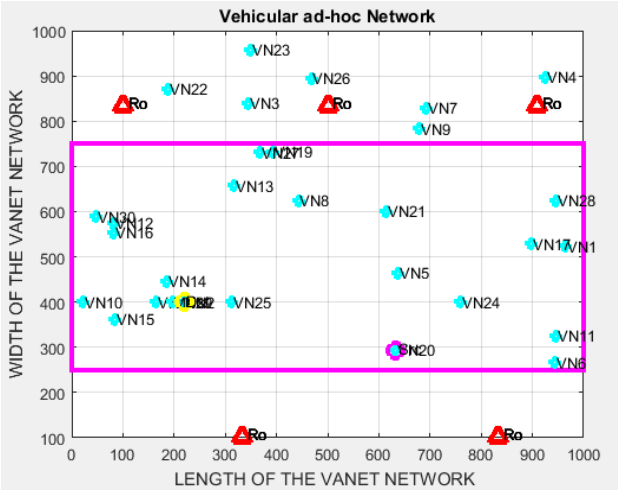

Fig.4. Found Source and Destination Node

Fig.4. Searches the source and destination, randomly decide in the vehicular ad-hoc networks. The above figure shows the vehicular ad-hoc network architecture and plots the vehicle nodes in the network area and deploys the road side unit. The roadside unit for expanding the availability of vehicular impromptu systems is esteemed essential for adapting to the fractional entrance of Devoted Short Range Correspondences (DSRC) radios into the market at the underlying phases of DSRC sending. After sending the RSU, we found the sound and goal.

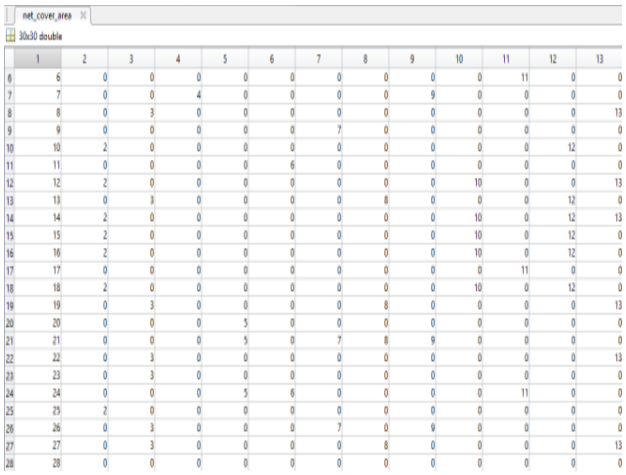

Fig.5. Coverage Set design and Distance Calculated

The above figure defines that the coverage set depends on the distance evaluation in the VANET network and has own source and destination node. In coverage set design, to evaluate the distance and range of the coverage area.

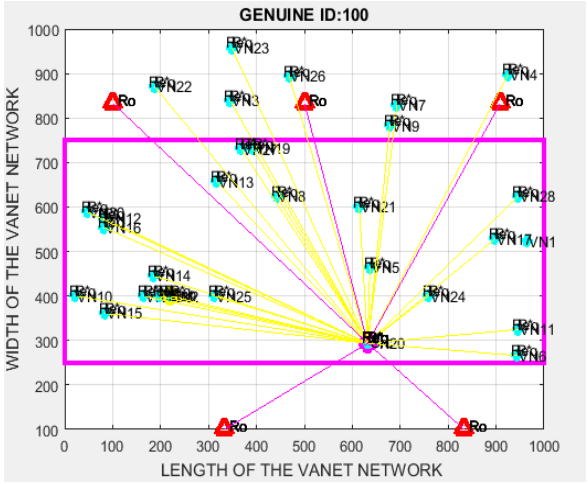

Fig.6.Genuine id

The above figure defined that the comparison between DELAY proposed and existing work in B-OADV, AODV AND PSOA algorithm. In PSOA algorithm implement to prevent the un-authorized node to mitigate the effect and decrease the delay.

TABLE 2. Comparison between proposed and Existing Work – End to End Delay (ms)

Algorithms	**B-AODV**	**AODV**	**PSOA**
Delay (ms)	15.32	16.24	1.4 ~ 14

The above figure defined that the comparison between OVERHEAD proposed and existing work in B-AODV, AODV and PSOA Algorithm. In PSOA algorithm implement to prevent the un-authorized node to mitigate the effect and decrease the Overhead.

TABLE 3. Comparison between proposed and Existing Work – Overhead (db)

Algorithms	**B-AODV**	**AODV**	**PSOA**
Overhead (db)	2609	5120	2000

The above figure defined that the comparison between throughput proposed and existing work in B-AODV, AODV AND PSOA Algorithm. In PSOA algorithm implement to prevent the un-authorized message node to mitigate the effect and increase the Delivery Rate values.

TABLE 4. Comparison between proposed and Existing Work – PDR (Packet Delivery Rate)

Algorithms	**B-AODV**	**AODV**	**PSOA**

PDR (%) `	0.88	0.70	0.90

The above figure defined that the comparison between throughput proposed and existing work in B-AODV, AODV and PSOA algorithm. In PSO algorithm implement to prevent the un-authorized node to mitigate the effect and increase the throughput values.

TABLE 5. Comparison between proposed and Existing Work – Throughput (%)

Algorithms	**B-AODV**	**AODV**	**PSOA**
Throughput (%)	55.40	49.35	60.00

VI. CONCLUSION AND FUTURE SCOPE

In conclusion, vehicular ad-hoc network is the main objective preserving security to van drivers by start independent announcement with the neighbor vehicle nodes. Every vehicle node in the AD-HOC network executes as an intelligent vehicle node featured by high-mobility and formation of dynamic networks. In this proposed work, we work on the vehicle to vehicle communication have appeared as a reliable solution to various of inconveniences faces by commuters on the road areas. In these vehicle nodes have a haven of central overprotective ability and form a different vehicle network, features by self-organization of vehicle nodes and dynamic movement, principal to VANETs. In research work, has implemented a B-AODV routing protocol to find the traffic issues in the network and PSOA algorithm to reduce the packet losses and overhead metric in the network. In experimental consequences, improve the performance metric with Overhead, End-to-End Delay, Network load decreases and increase the packet delivery rate and throughput of the network.

The future work would study the performance at different routing protocols that fall under different categories. Also studying the security threats of VANETs and propose countermeasures for them. It can implement an encryption approach to secure communication with a secret key.

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