IARJSET

ISSN (Online) 2393-8021
ISSN (Print) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Vol. 7, Issue 4, April 2020

Survey on OLSR Routing Protocol Optimization for VANET's

Prof.Shriganesh Shridhar Mane

JSPM's Bhivrabai Sawant Polytechnic, Wagholi, Pune

Abstract: It is the survey paper of VANETs are a subset of MANETs in which communication nodes are mainly vehicles. As such, this kind of network should deal with a great number of highly mobile nodes, eventually dispersed in different roads. In VANETs, vehicles can communicate each other (V2V, Vehicle-to-Vehicle communications). They can connect to an infrastructure (V2I, Vehicle-to-Infrastructure) or Infrastructure to Vehicle (I2V) to get some service. This infrastructure is assumed to be located along the roads. Some motivations of the promising VANET technology include, Increase traveler safety, Enhance traveler mobility, Decrease travelling time, Conserve energy and protect the environment, Magnify transportation system efficiency, **V**EHICULAR ad hoc networks (VANETs) [1] are self configuring networks where the nodes are vehicles (equipped with onboard computers), elements of roadside infrastructure, sensors, and pedestrian personal devices. WiFi (IEEE 802.11-based) technologies are used for deploying such kind of networks. At present, the IEEE group is completing the IEEE 802.11p and IEEE 1609 final drafts, which are known as "Standard Wireless Access in Vehicular Environments" (WAVE), specifically designed for VANETs. This technology presents the opportunity to develop powerful car systems capable of gathering, processing, and distributing information.

For example, a driver assistance system could collect accurate and up-to-date data about the surrounding environment, detect potentially dangerous situations, and notify the driver [2].

Keywords: VANET,WiFi, IEEE protocols

I.INTRODUCTION

In VANETs, the WiFi limitations in coverage and capacity of the channel, the high mobility of the nodes, and the presence of obstacles generate packet loss, frequent topology changes, and network fragmentation. Thus, a great deal of effort is dedicated to offer new medium access control access strategies [3] and to design efficient routing protocols [4], [5]. In turn, in such kind of networks, routing is a challenging task since there is no central entity in charge of finding the routing paths among the nodes. Different routing strategies have been defined based on prior ad hoc network architectures by targeting the specific VANET needs of scenarios and applications. These protocols can be grouped into topology based (proactive, e.g., stination-sequenced distance-vector and optimized link state routing (OLSR), reactive, e.g., ad hoc On demand distance vector (AODV) and dynamic source routing (DSR).

Most of the VANET applications critically rely on routing protocols. Thus, an optimal routing strategy that makes better use of resources is crucial to deploy efficient VANETs that actually work in volatile networks. Finding well-suited parameter configurations of existing mobile ad hoc network (MANET) protocols is a way of improving their performance, even making the difference between a network that does work or does not, e.g., networks with high routing load suffer from congestion and cannot ensure timely and reliable delivery of messages [6].

In the present paper, we aim at defining and solving an offline optimization problem to efficiently and automatically tune OLSR [7], which is a widely used MANET unicast proactive routing protocol. Although specific routing protocols are emerging for VANET networks, a number of authors are currently using OLSR to deploy vehicular networks [8]–[11]. This protocol has been chosen mainly because it presents a series of features that make it well suited for VANETs. It exhibits very competitive delays in the transmission of data packets in large networks (which is an important feature for VANET applications), it adapts well to continuous topology changes, and the OLSR has simple operation that allows it to be easily integrated into different kinds of systems. More details about the use of OLSR in VANETs are provided in the following section.

In this paper, we define an optimization problem to tune the OLSR protocol, obtaining automatically the configuration that best fits the specific characteristics of VANETs. An optimization problem is defined by a search space and a quality or fitness function. The search space restricts the possible configurations of a solution vector, which is associated with a numerical cost by the fitness function. Thus, solving an optimization problem consists of finding the least-cost configuration of a solution vector. Inspite of the moderate number of configurable parameters that govern OLSR [7], the number of possible combinations of values that they can take makes this task very hard.

DOI 10.17148/IARJSET.2020.7424

In **summary, the main contributions of this paper are the following.**
1.We propose an optimization strategy in which a number of metaheuristic algorithms are (separately) coupled with a network simulator ($ns-2$) to find quasi-optimal solutions.
2.This optimization strategy is used in this paper to find as fine-tuned as possible configuration parameters of the OLSR protocol, although it could directly be used also for a number of other routing protocols (AODV, PROAODV, GPSR, FSR, DSR, etc.).
3.We obtain OLSR configurations that automatically out- perform the standard one and those used by human experts in the current state of the art.
4.We generate a set of realistic VANET scenarios based in the real area of Málaga, Spain.

II..VANET ARCHITECTURE AND CHARACTERISTICS

2.1 VANET SYSTEM ARCHITECTURE

VANET system architecture consists of different domains and many individual components as depicted in Figure 2.1 [7].

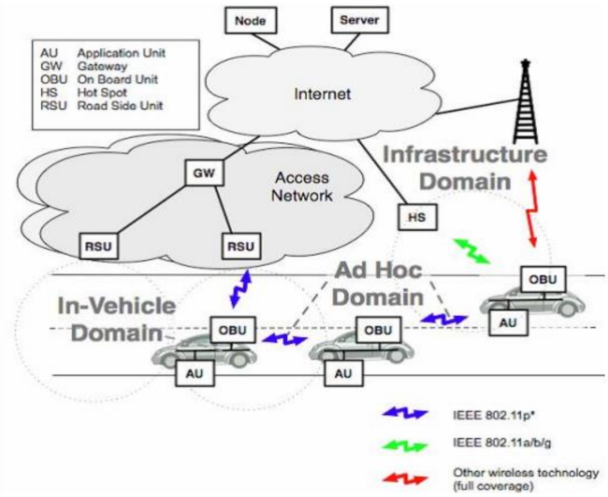


Fig. 2.1 VANET System Architecture

- **In-vehicle domain :**

This consists of an on-board unit (OBU) and one or more applications units (AU)inside a vehicle. AU executes a set of applications utilizing the communication capability of the OBU. An OBU is at least equipped with a (short range) wireless communication device dedicated for road safety, and potentially with other optional communication devices (for safety and non-safety communications). The distinction between AU and OBU is logical; they can also reside in a single physical unit.

- **Ad hoc domain :**

An ad hoc domain is composed of vehicles equipped with OBUs and road-side units (RSUs), forming the VANET. OBUs form a mobile ad hoc network which allows communications among nodes without the need for a centralized coordination instance. OBUs directly communicate if wireless connectivity exists among them; else multi-hop communications are used to forward data

- **Infrastructure domain :**

The infrastructure consists of RSUs and wireless hotspots (HT) that the vehicles access for safety and non-safety applications. While RSUs for internet access are typically set up by road administrators or other public authorities, public or privately owned hot spots are usually set up in a less controlled environment.

2.2 VANET APPLICATION

The VANET application can be divided into two major categories [10]:

2.2.1 Safety

Safety applications have the ability to reduce traffic accidents and to improve general safety. These can be further categorized as safety-critical and safety-related applications. In the design of security, it should be made sure safety messages are not forged.

Safety-critical :

These are used in the case of hazardous situations (e.g. like collisions) [11]. It includes the situations where the danger is high or danger is imminent [5]. Safety-critical applications involve communication between vehicles (V2V) or between vehicles and infrastructure/infrastructure and vehicles (V2I/I2V).

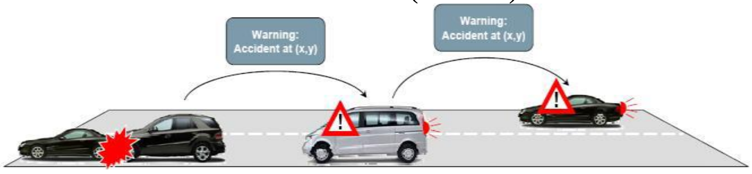


Fig. 2.2 Safety Critical Scenario [16]

- **Safety-related :**

These include safety applications where the danger is either low (curve speed warning) or elevated (work zone warning), but still foreseeable [6]. In safety-related applications, the latency requirements are not as stringent as in the case of safety-critical ones. Safety-related applications can be V2V or V2I/I2V.

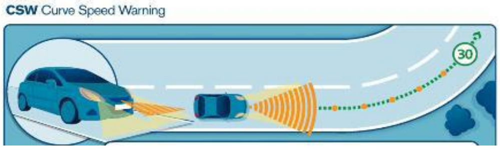


Fig. 2.3 Safety Related Scenario

2.2.2 Non-safety

These are applications that provide traffic information and enhance driving comfort. Non-safety applications mostly involve a V2I or I2V communication [10][11]. These services access the channels in the communication system, except the control channel. They access the channel in a low priority mode compared to safety applications.

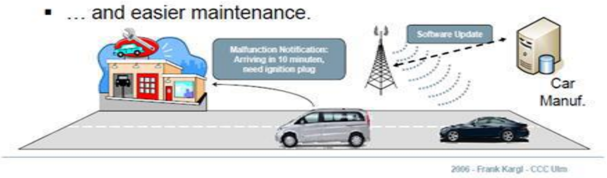


Fig. 2.4 Non - Safety Related Scenario [9]

Traffic optimization :
Traffic information and recommendations, enhanced route guidance etc.
Infotainment :
The Infotainment services are Internet access, media downloading, instant messaging etc.
Payment services :
Payment services like Electronic toll collection, parking management etc.
Roadside service finder :
Finding nearest fuel station, restaurants etc. This involves communication of vehicles with road side infrastructure and the associated database.
Weather Information system :
Optain the weather information using GIS System,and monitor the weather information.
Bus Information System:
Optain and monitor bus stop information Public transport information system
Real time information:
Automatic traffic control,public transport,parking,airport arrivals/departures.news, banking, stock

2.3 VANET Characteristics

VANET has some unique characteristics which make it different from MANET as well as challenging for designing VANET applications.

High Dynamic topology: The speed and choice of path defines the dynamic topology of VANET. If we assume two vehicles moving away from each other with a speed of 60 mph (25m/sec) and if the transmission range is about 250m, then the link between these two vehicles will last for only 5 seconds (250m/ 50ms-1). This defines its highly dynamic topology.

DOI 10.17148/IARJSET.2020.7424

Frequent disconnected Network: The above feature necessitates that in about every 5 seconds or so, the nodes needed another link with nearby vehicle to maintain seamless connectivity. But in case of such failure, particularly in case of low vehicle density zone, frequent disruption of network connectivity will occur. Such problems are at times addressed by road-side deployment of relay nodes.

Mobility Modeling and Prediction: The above features for connectivity therefore needed the knowledge of node positions and their movements which as such is very difficult to predict keeping in view the nature and pattern of movement of each vehicles. Nonetheless, a mobility model and node prediction based on study of predefined roadways model and vehicle speed is of paramount importance for effective network design.

Communication Environment: The mobility model highly varies from highways to that of city environment. The node prediction design and routing algorithm also therefore need to adapt for these changes. Highway mobility model, which is essentially a one-dimensional model, is rather simple and easy to predict. But for city mobility model, street structure, variable node density, presence of buildings and trees that behave as obstacles to even small distance communication make the model application that very complex and difficult.

- **Delay Constraints:** The safety aspect (such as accidents, brake event) of VANET application warrants on time delivery of message to relevant nodes. It simply cannot compromise with any hard data delay in this regard. Therefore high data rates are not as important an issue for VANET as overcoming the issues of hard delay constraints.

Interaction with onboard sensors: This sensors helps in providing node location and their movement nature that are used for effective communication link and routing purposes.

III.VANET ROUTING PROTOCOLS

3.1 Ad hoc On-Demand Distance Vector (AODV) Routing Protocol

The Ad hoc On-Demand Distance Vector (AODV) [8] algorithm enables dynamic, self-starting, multihop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. AODV allows mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destinations that are not in active communication. AODV allows mobile nodes to respond to link breakages and changes in network topology in a timely manner. The operation of AODV is loop-free, and by avoiding the Bellman-Ford "counting to infinity" problem offers quick convergence when the adhoc network topology changes (typically, when a node moves in the network). When links break, AODV causes the affected set of nodes to be notified so that they are able to invalidate the routes using the lost link. Route Requests (RREQs), Route Replies (RREPs) and Route Errors (RERRs) are message types defined by AODV. In AODV the source node and the intermediate nodes store the next hop information corresponding to each flow for data packet transmission. The disadvantage of this protocol is that the intermediate nodes can lead to inconsistent routes if the source sequence number is very old and the intermediate nodes have a higher, but not the latest destination sequence number, thereby having stale entries. This is show in Fig. 3.2

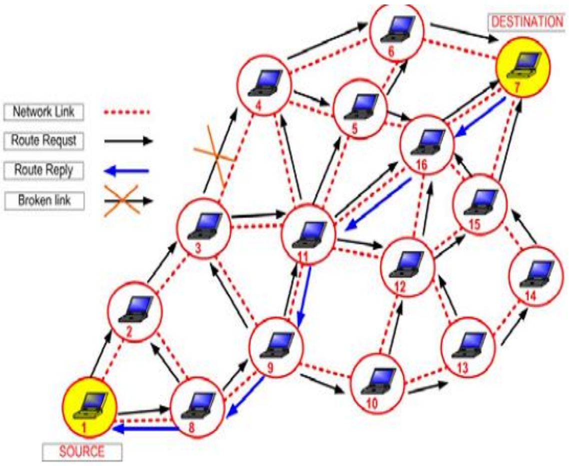


Fig. 3.2 AODV Routing Mechanism

3.2 Optimized Link State Routing Protocol (OLSR)

The Optimized Link State Routing Protocol (OLSR) is developed for mobile ad hoc networks. It operates as a table driven, proactive protocol, i.e. exchanges topology information with other nodes of the network regularly. Each node selects a set of its neighbor nodes as "multipoint relays" (MPR). In OLSR, only nodes, selected as such MPRs are responsible for forwarding control traffic, intended for diffusion into the entire network. MPRs provide an efficient mechanism for flooding control traffic by reducing the number of transmissions required. Nodes, selected as MPRs, also have a special responsibility when declaring link state information in the network. Indeed, the only requirement for

OLSR to provide shortest path routes to all destinations is that MPR nodes declare link-state information for their MPR selectors. Additional available link-state information may be utilized, e.g., for redundancy. Nodes which have been selected as multipoint relays by some neighbor node(s) announce this information periodically in their control messages. Thereby a node announces to the network, that it has reachability to the nodes which have selected it as an MPR. In route calculation, the MPRs are used to form the route from a given node to any destination in the network. Furthermore, the protocol uses the MPRs to facilitate efficient flooding of control messages in the network. A node selects MPRs from among its one hop neighbors with "symmetric", i.e., bi-directional, linkages. Therefore, selecting the route through MPRs automatically avoids the problems associated with data packet transfer over uni-directional links (such as the problem of not getting link-layer acknowledgments for data packets at each hop, for link-layers employing this technique for unicast traffic.

The Optimized Link State Routing (OLSR) protocol is one such table-driven protocol. In OLSR, nodes exchange messages with other nearby nodes of the network on a regular basis to update topology information on each node. Nodes determine their one hop neighbours.

MPR nodes have two roles:

a) When the selector sends or forwards a broadcast packet, only its MPR nodes among all its neighbors forward the packet;

b) The MPR nodes periodically broadcast its selector list throughout the MANET (again, by means of MPR flooding). Thus every node in the network knows which MPR nodes could reach every other node. Note that a) reduces the number of retransmissions of topology information broadcast, and b) reduces the size of broadcast packet. As result, much more bandwidth is saved compared with original link state routing protocols.

c) With global topology information stored and updated at every node, a shortest path from one node to every other node could be computed with Dijkstra's algorithm, which goes along a series of MPR node.

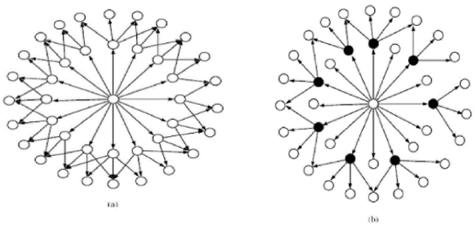


Fig. 3.3 OLSR Routing Mechanism

3.3 Dynamic Source Routing (DSR)

The Dynamic Source Routing protocol (DSR) is (Perkins, 2007), an on demand routing protocol. DSR is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. Using DSR, the network is completely self-organizing and self-configuring, requiring no existing network infrastructure or administration. The DSR protocol is composed of two main mechanisms that work together to allow the discovery and maintenance of source routes in the ad hoc network [3]:

Route Discovery is the mechanism by which a node S wishing to send a packet to a destination node D obtains a source route to D. Route Discovery is used only when S attempts to send a packet to D and does not already know a route to D.

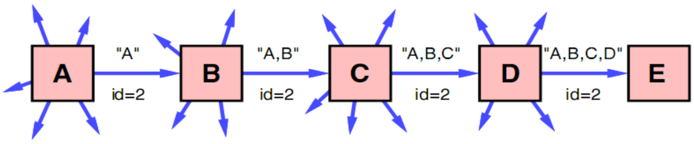


Fig. 3.4 Route Discovery example

Node **A** is the initiator, and node **E** is the target. When another node receives a ROUTE REQUEST, if it is the target of the Route Discovery, it returns a ROUTE REPLY message to the initiator of the Route Discovery, giving a copy of the accumulated route record from the ROUTE REQUEST; when the initiator receives this ROUTE REPLY, it caches this route in its Route Cache for use in sending subsequent packets to this destination. Otherwise, if this node receiving the ROUTE REQUEST has recently seen another ROUTE REQUEST message from this initiator bearing this same request id, or if it finds that its own address is already listed in the route record in the ROUTE REQUEST message, it discards the REQUEST. Otherwise, this node appends its own address to the route record in the ROUTE REQUEST message and propagates it by transmitting it as a local broadcast packet (with the same request id).

PROBLEM OVERVIEW

Exchanging up-to-date information among vehicles is the most salient feature of a VANET. To do so, the packets have to travel through the network from one node to the others, which is a complex task in networks having high mobility and no central authority. The routing protocol operates in the core of VANETs, finding updated paths among the nodes to allow the effective exchange of data packets. For this reason, this paper deals with the optimization of a routing protocol, specifically the OLSR protocol [2].
This protocol has been chosen since it presents a series of features that make it suitable for highly dynamic ad hoc networks and concretely for VANETs. These features are the following.
1.OLSR is a routing protocol that follows a proactive strat- egy, which increases the suitability for ad hoc networks with nodes of high mobility generating frequent and rapid topological changes, like in VANETs [9], [10].
2.Using OLSR, the status of the links is immediately known. Additionally, it is possible to extend the protocol information that is exchanged with some data of quality of the links to allow the hosts to know in advance the quality of the network routes.
3The simple operation of OLSR allows easy integration into existing operating systems and devices including smartphones, embedded systems, etc.) without changing
4) The OLSR protocol is well suited for high density networks, where most of the communication is concentrated between a large number of nodes (as in VANETs)
5) OLSR is particularly appropriate for networks with applications that require short transmission delays (as most of warning information VANET applications)

The main drawback of OLSR is the necessity of maintaining the routing table for all the possible routes. Such a drawback is negligible for scenarios with few nodes, but for large dense networks, the overhead of control messages could use additional bandwidth and provoke network congestion. This constrains the scalability of the studied protocol.

IV.OLSR PROTOCOL

OLSR is a proactive link-state routing protocol designed for MANETs (VANETs), which show low bandwidth and high mobility. OLSR is a type of classical link-state routing protocol that relies on employing an efficient periodic flooding of control information using special nodes that act as multipoint relays (MPRs). The use of MPRs reduces the number of required transmissions [12]. OLSR daemons periodically exchange different messages to maintain the topology information of the entire network in the presence of mobility and failures.

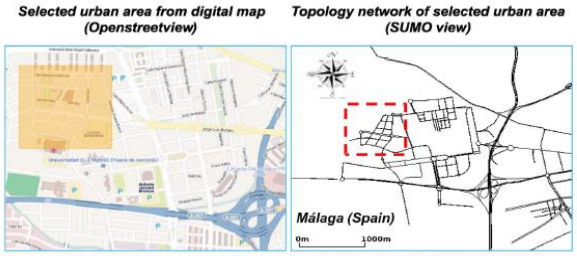
The core functionality is performed mainly by using three different types of messages:
1) HELLO; 2) topology control (TC); and 3) multiple interface declaration (MID) messages.
1) HELLO messages are exchanged between neighbor nodes (one-hop distance).

EXPERIMENTS

The simulation task should offer a network environment as close as possible to the real world environment. Following this idea, we make an effort to define realistic scenarios, where VANETs may be deployed. In this section, we define the urban scenario used in our simulations. Next, we present the experimental setup, taking into account the parameter settings for both the metaheuristic algorithms and the $ns - 2$ simulation.

5.1. Urban VANET Scenario

Since $ns - 2$ is a network simulator of general purpose, it does not offer a way for directly defining realistic VANET simulations, where the nodes follow the ehavior of vehicles



* Real urban information is captured from digital map and exported to topology network in SUMO/NS2 instance

Fig.Malaga real urban VANET scenario.

in a road, traffic lights, traffic signs, etc. To solve this problem, we have used the Simulation of Urban MObility (SUMO) road traffic simulator to generate realistic mobility models [14]. This tool returns traces with the mobility definitions that can be used by $ns - 2$. The main advantage of employing traffic simulators is that they can be used to generate realistic VANET environments by automatically selecting real areas from freely available digital maps (OpenStreetMap,1 as specified in Fig. 2), taking into account road directions, traffic lights and signs, etc. The VANET instance defined in this paper contains 30 cars moving through the roads selected of an area of 1200 × 1200 m2 from the city downtown of Málaga (Spain) during 3min. The area inside the dotted line box of Fig. 2 shows the roads taken into account to define the VANET urban scenario for our experiments. Through the simulation time, a set of cars exchange data, and as in an urban road, their speed fluctuates between 10 km/h (2.78 m/s) and 50 km/h (13.88 m/s). For this VANET scenario, we have defined a specific data flow trustworthy representing different possible communications that may exist. The data flow model performs 10 sessions of a constant bit rate (CBR) data generator that operates over user datagram protocol (UDP) agents defined in the nodes (vehicles). This way, the interconnected vehicles exchange the data generated by the CBR agents. The CBR data packet sizeis 512 B, and the packet rate is 4 packets/s. The remaining simulation parameters are summarized in Table II for future reproduction purposes.

V.RESULTS

This section presents the experimental results from four different points of view. First, we show metaheuristic and RAND performances when solving the OLSR optimization problem. Second, we compare the obtained OLSR parameter configurations against several configurations found in the literature. Third, the obtained solutions are also evaluated on multiple different scenarios to check whether optimized OLSR parameters can be used in general or not. Fourth, we analyze the influence of the different OLSR parameters in the global QoS provided by the network.

VI.CONCLUSION

In this paper, we have addressed the optimal parameter tuning of the OLSR routing protocol to be used in VANETs by using an automatic optimization tool. For this task, we have defined an optimization strategy based on coupling optimization algorithms (PSO, DE, GA, and SA) and the $ns - 2$ network simulator. In addition, we have compared the optimized OLSR configurations with the standard one in RFC 3626 as well as with human expert configurations found in the current state of

In the light of the experimental results, we can conclude the following.

1) In terms of the performance of the optimization techniques used in this paper, SA outperforms the other studied metaheuristic algorithms when solving the defined OLSR optimization problem because it is the best ranked after the Friedman test. However, PSO presents the best tradeoff between the performance and the execution time requirements. In turn, a parallel version of PSO running in multiple processors can also further reduce the computational time derived from large VANET simulations. This way, we can offer accurate OLSR configurations to experts in reasonable design times.

2) When using the automatically tuned configurations over the VANET scenario employed during the optimization task, all the packets are delivered correctly (PDR = 100%), increasing the PDR regarding the standard configuration by 8.34% and between 6.66% and 28.57% regarding the other expert-defined configurations. In turn, the use of the optimized configurations dramatically reduces the routing load generated by OLSR.

3) Globally, the validation experiments show that the optimized configurations reduced the network workload, generating about the half of the routing load than the RFC 3626 configuration. By reducing the routing load, the routing tables are updated less frequently, calculating routing paths 27% longer than the standard version. Nevertheless, the mitigation of the OLSR-related congestion problems by optimized configurations generally allowed to shorten the packet delivery times. In turn, these features were obtained while keeping the degradation of amount of delivered data lower than 5%.

4) According to these results, the automatically tuned OLSRs by using metaheuristics are more scalable than the standard version because they are less likely tobe affected by medium access and congestion problems. Specifically, the PSO obtained configuration obtained the best tradeoff between the

VII. ADVANTAGES AND DISADVANTAGES

7.1 Proactive (table-driven)

Advantages

- No Route Discovery is required.
- Low Latency for real time applications.

Disadvantages

- Unused paths occupy a significant part of the available bandwidth.

7.2 Reactive (On Demand)

Advantages

-To update routing table not require periodic flooding the network. Flooding requires when it is demanded.

DOI 10.17148/IARJSET.2020.7424

-Beaconless so it saves the bandwidth.

Disadvantages

- For route finding latency is high.
- Excessive flooding of the network causes disruption of nodes communication.

REFERENCES

[1]. W. Zhang, A. Festag, R. Baldessari, and L. Le, "Congestion control for safety messages in VANETs: Concepts and framework," in *Proc. 8th ITST,* Oct. 2008, pp. 199–203.
[2]. T. Clausen and P. Jacquet, "Optimized link state routing protocol (OLSR)," ETF RFC 3626, 2003. [Online].. Available: http://www.ietf.org/rfc/rfc3626.txt
[3]. T. Chen, O. Mehani, and R. Boreli, "Trusted routing for VANET," in *Proc. 9th Int. Conf. ITST,* M. Berbineau,M. Itami, and G.Wen, Eds., Oct. 2009, pp. 647–652.
[4]. J. Haerri, F. Filali, and C. Bonnet, "Performance comparison of AODV and OLSR in VANETs urban environments under realistic mobility patterns," in *Proc. 5th Annu. Med-Hoc-Net,* S. Basagni, A. Capone, L. Fratta, and G. Morabito, Eds., Lipari, Italy, Jun. 2006.
[5]. C. Gómez, D. García, and J. Paradells, "Improving performance of a real ad hoc network by tuning OLSR parameters," in *Proc. 10th IEEE ISCC*, 2005, pp. 16–21.
[6]. C. Blum and A. Roli, "Metaheuristics in combinatorial optimization: Overview and conceptual comparison," *ACM Comput. Surv.*, vol. 35, no. 3, pp. 268–308, Sep. 2003.
[7]. K. Parsopoulos and F. Vrahatis, "Unified particle swarm optimization for solving constrained engineering optimization problems," in *Advances in Natural Computation*. New York: Springer- [19]. H. Shokrani and S. Jabbehdari, "A novel ant-based QoS routing for mobile ad hoc networks," in [20]. C. Huang, Y. Chuang, and K. Hu, "Using particle swarm optimization for QoS in ad-hoc multicast," *Eng. Appl. Artif. Intell.*, vol. 22, no. 8, pp. 1188– 1193, Dec. 2009.
[8]. Y. Ge, T. Kunz, and L. Lamont, "Quality of service routing in ad-hoc networks using OLSR," in *Proc. 36th HICSS*, 2003, pp. 9–18.
[9]. A. Huhtonen, "Comparing AODV and OLSR routing protocols," in *Proc. Telecommun. Softw. Multimedia*, 2004, pp. 1–9.
[10]. D. Nguyen and P. Minet, "Analysis of MPR selection in the OLSR protocol," in *Proc. Int. Conf. Adv. Inf. Netw. Appl. Workshops*, 2007, vol. 2, pp. 887–892.
[11]. E. Alba, S. Luna, and J. Toutouh, "Accuracy and efficiency in simulating VANETs," in *Proc. MCO—Communications Computer Information Science*, L. T. H. An, P. Bouvry, and T. P. Dinh, Eds., 2008, vol. 14, pp. 568–578.
[12].D. Krajzewicz, M. Bonert, and P. Wagner, "The open source traffic simulation package SUMO,"
[13]. R. Eberhart and Y. Shi, "Comparing inertia weights and constriction factors in particle swarm optimization," in *Proc. IEEE CEC*, La Jolla, CA, 2000, vol. 1, pp. 84–88.
[14].J. Toutouh and E. Alba, "An efficient routing protocol