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Comparison of AODV and Optimized AODV in Vehicular Ad hoc Networks

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Abstract: In this paper, the work is done to identify the need for QoS improvement in VANETs. In vehicular Ad-hoc Network (VANET) a restricted coverage of Wi-Fi and extremely mobile nodes creates the topology highly dynamic and frequently disconnecting. Subsequently, Quality of Service turn out to be an essential issue. Investigation related to work signifies that, an effective routing methodology plays a vital role to improve the QoS parameters. As in opportunistic routing path is not predefined so in normal schemes it leads to packet drop and reduces throughput to overcome these limitations in VANETs, AODV (Ad Hoc on Demand Vector) routing path is optimized by applying a Meta heuristic algorithm – Ant Colony Optimization (ACO). Opportunistic Network Environment (ONE simulator) has been used to carry out the experiment. To measure the performance we used various parameters, such as packet drop, overhead ratio, average latency and the throughput. To create the simulation more realistic a city map has been used in the simulator.

Keywords: VANET, ACO, AODV, ONE Simulator, Throughput, Overhead Ratio, Packet Drop, Average Latency

I. INTRODUCTION

VANETs are self-designing systems in which vehicles goes about as the nodes, it gives a chance to build up an operational vehicular framework for different exercises like social affair of data, handling of data and distribution of data which can be spread in different applications . Here we have primarily two types of models in VANET environment are Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I). Wi-Fi (IEEE 802.11) based advancements are utilized for exhibiting these systems. The improvements in convenient interchanges and the contemporary systems in specially appointed systems allow differing usage basic plan for vehicular systems in the fundamental street, metropolitan and farmland airs to upkeep numerous applications with different QoS prerequisites [3] [25] [26].

As, VANET is a sub-class of MANET So, it acquire few attributes of them, e.g. both of them are self-arranging systems and made out of mobile nodes.

1. Sufficient power: power scarcity is not a serious in VANETs unlike in MANET, VANETs are supported by stronger batteries which are in possession of extensive storage and rechargeable property.

2. Fruitful capabilities: There is relatively big space in vehicles, so various devices owning significant computing, communication and sensing capabilities can be installed which makes vehicles capable of powerful functions and high computational abilities [1].

3. Predictable mobility: Unlike MANETs in which mobile nodes move randomly the movements of vehicles in VANETs are controlled by street topologies, traffic lights and regulations and the future position of the vehicle can be predicted based on roadway information [10].

4. Large Scale application scenarios: VANETs are always laid out in the main road/metropolitan environments which constitute large networks and include a high number of mobile nodes, while MANETs are usually studied in a limited size environment.

5. Rapid network topology changes: Vehicles in VANETs are moving with high speed and changes their topology dynamically and communication links are unstable which leads to network disconnections [2].

Now, as this topology is varying regularly a dependable correspondence with essential QoS turns out to be vital as for directing convention which requests change. There are numerous conventions those have been suggested and assessed for VANET. These are characterized in view of before impromptu system structures by focusing on the specific VANET situations and a few applications. For example, Dynamic Source Routing, Optimized Link State Routing and so forth. There are techniques/calculations, for example, meta-heuristic calculations, which can be utilized to streamline directing convention to expand the general QoS necessities in vehicular systems [3] [24].

In the case of Vehicular environment, application and estimation generally encompass simulators because working and procedures of an enormous number of real vehicles are very costly. Sharing of up-to-date information is most significant, otherwise, it effects loss of lives.

Message exchange is a troublesome assignment, for example, VANET meanwhile they are exceptionally versatile and deprived of a central power one of the standards to enhance QoS considerations in VANET is to enhance a routing protocol itself [3]. Discovery of an upgraded way among the nodes to permit the successful trade of messages know how to guarantee enhanced execution. Consequently, an ideal directing methodology that makes more utilization of assets is fundamental. Discovering appropriate parameters, designs of a reasonable steering convention of VANETs is a method of refining their execution as far as QoS parameters. Delay and overhead ratio can enhance the general QoS improvement [3] [9].

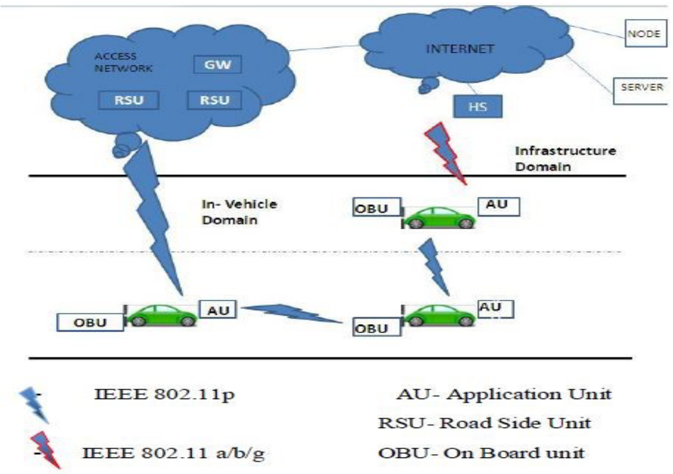

Figure 1 Architecture of VANET

This paper consist section II a discussion on the related work, section III presents Natural Ant Colony, section IV presents the simulation framework in detail, section V the metrics and the results of simulations are provided and finally VI section concludes this paper.

II. RELATED WORK

In a case of Quality of Service of Mobile Ad-hoc networks (MANETs) various authors have already discussed but it is high time to discuss the QoS support for Vehicular Ad hoc Networks as very less attention has been given to this. As in MANET most of the existing work is on the design of MAC protocol. IEEE 802.11 can be applied for VANET and the analysis of its performance can be studied [14]. The performance in case of MANET mostly depends on the routing protocol, therefore, routing protocol will play a vital role in improving the QoS in it. Various studies have been done on the routing protocols the most comprehensive one is done by Monarch Project In which the comparison of various routing protocols has been done e.g. DSDV, AODV, TORA and DSR. It has been shown that AODV and FSR are suitable protocols but TORA and DSR are unsuitable for VANET. Juan Luo et al. These are networks having an extensive variety of application in an area such as traffic monitoring, medical care, and robotic exploration. In this paper, authors have focused on the minimization of energy consumption and maximization of the network period for data relay in 1-D queue network. Broad simulations and real testbed outcomes showed that the planned solution by the authors ENS-OR be able to considerably increase the network presentation on energy saving and wireless connectivity in comparison with other WSN structures [4] [12].

Various articles summarized the characteristics and issues with respect to VANETs. As in [15] [16] authors have discussed the challenges in research for routing in VANET also compared the performance of routing protocols. Hartenstein and Laberteaux presents an outline of communication and networking features of VANET [17]. Raya and Hubaux confessed the security issues of VANET. Moreover, provided a set of security rules [18]. In [19] authors proposed large range mobility models taxonomy on VANETs. All these articles are related to a specific research area that is VANET.

Metaheuristic algorithms are very suitable for solving VANET routing problems as they are very complex and having no central authority. Garcia-Nieto et al. showed the file transmission service in real VANET set-ups using different metaheuristic techniques. The study has been done on the four different algorithms particle swarm optimization, Differential Evolution, Genetic algorithm and Simulated Annealing and found that Particle Swarm optimization is best for QoS [11][23]. Moreover, Ant Colony optimization is most suitable for VANETs.

III. ANT COLONY OPTIMIZATION

Ant's lives in colonies as these insects are social and because of their collaboration they show a complex behavior. The interesting point is that these insects discover the shortest path between their nest and food source even while an ant moves from the nest and the food sources. While moving between their sources of food and nest ants deposit a chemical named as a pheromone [5]. It is an odorous chemical in the presence of which ants follow the trail. Moreover, various experiments have shown that's probabilistically ants prefer to follow a path with more concentration. The higher the concentration of pheromone the more its desirability. This behavior of ants helps to figure out a direct path between their nest and a foodstuff [5] [6] [7].

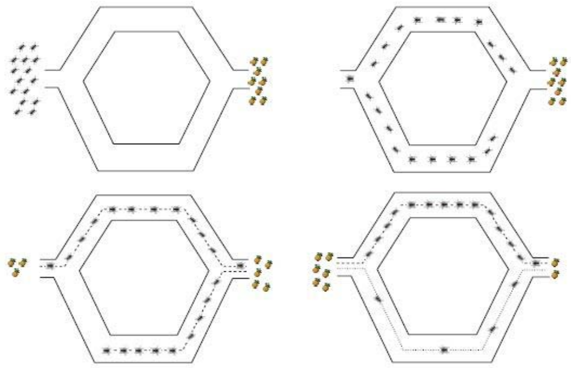

Figure 2 Embryonic behavior of the colony [5]

Figure 2 describes the mechanism that how ants find the shortest path. Initially, there is a clean environment means no pheromone is present, when ant has to choose at an intersection, they choose it randomly and as the shortest path is slightly having more pheromone trails the ant's decision is towards the shortest path and receives a more proportion of pheromone on returning way than that of longer path. In a meanwhile, in a natural way pheromone evaporates after some time depending on the ant species, floor type etc. [22]. And makes the less significant influence on the search of the shortest path and if this mechanism is used in a computer to scheme search procedure we will develop a local optima set of rules [21].

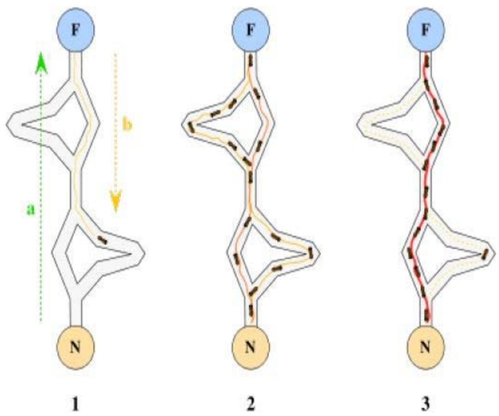

Figure 3 Shortest path finding in ACO

IV. SIMULATION FRAMEWORK

The planned structure is displayed in table 1. The aim of refining the QoS in VANETs is done using ONE simulator.

A meta-heuristic algorithm, Ant Colony Optimization (ACO) is pragmatic to obtain routing scenario and the simulation is carried out in ONE simulator. To create the model more representative genuine city plots with the simulator has been integrated [3] [4].

Table I Simulation framework

Parameters	Values
Simulator	The opportunistic Network Environment Simulator
Channel	Wireless Channel
Simulation time	15000 sec
Simulation Area	1000 * 1000 m
Number of nodes/vehicles	30, 60, 90, 120, 150, 180, 210, 240, 270, 300.

Opportunistic Network Environment is a simulation tool precisely aimed for DTN. ONE offers model environment for wide-ranging WSNs such as VANET, MANET etc. It can be easily used to perform simulation requirements, Eclipse a java based tool used for the purpose of programming. We configure ONE simulator with eclipse. Configuring one simulator with eclipse helps in the programming of different routing scheme and movement prototypes, as eclipse provides some integrated functions of java that supports in programming [13] [20]. Figure 4 depicts the working mechanism of ONE simulator.

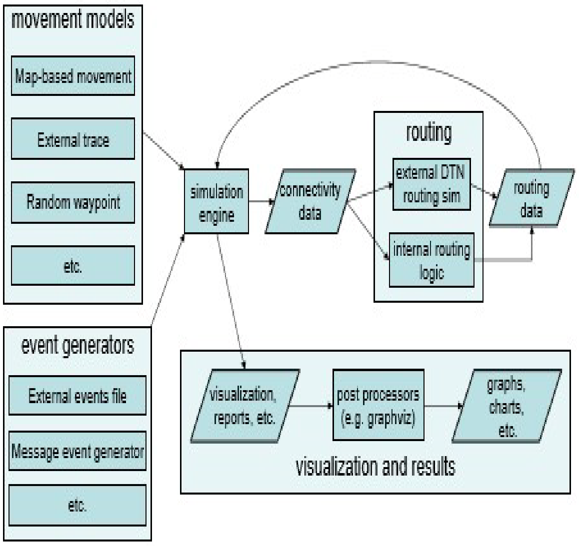

Figure 4 Opportunistic Network Environment Simulator [13]

V. RESULT ANALYSIS

A few of the parameters that were analyzed in research work are presented as follows.

A. Average Latency

Average Latency can be defined as the delay of a network specifies how long it takes for a bit of data to travel across the network from one node or endpoint to another. It is typically measured in multiples or fractions of seconds. Delay may differ slightly, depending on the location of the specific pair of communicating nodes. Average Latency does not have much significance in this scenario [29]. In figure 5, we see that the performance of AODV is slightly better than ACO due to stable maintenance of routing table.

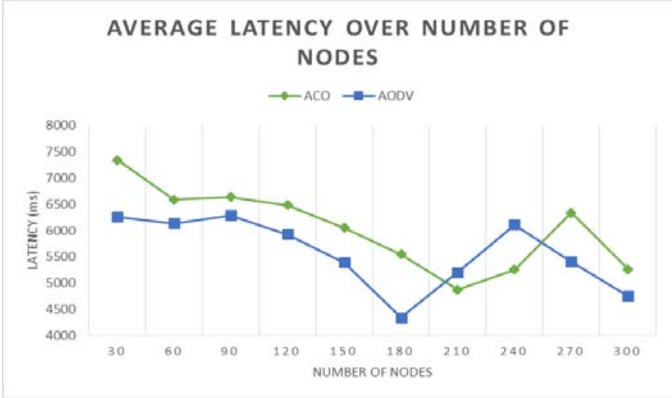

Figure 5 Average Latency

B. Ovehead Ratio

Overhead Ratio can be defined as the overhead as the average size of control overhead injected into the network for every successfully delivered data packet. Overhead refers to the processing time required by system software, which includes the operating system and any utility that supports application programs. Overhead sometimes describes the amount of processing time the installation of a particular feature will add to the amount already required by the program. In telecommunications, overhead refers to the processing time required by codes for error checking and control of transmissions [30].

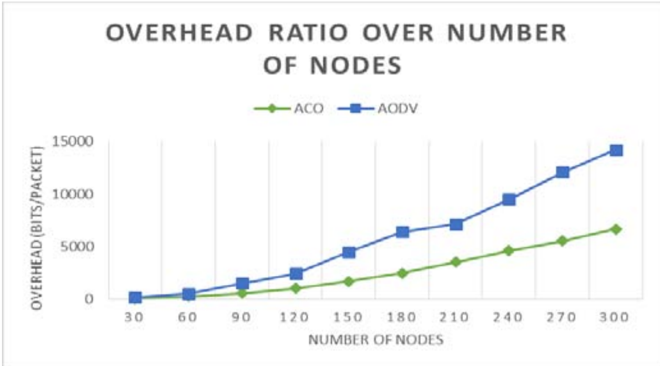

Figure 6 Overhead Ratio

C. Packet dropped

Packet Drop can be defined as Packet loss occurs when one or more packets of data travelling across a computer network fail to reach their destination. Packet loss is typically caused by network congestion. Packet loss is measured as a percentage of packets lost with respect to packets sent. The Transmission Control Protocol (TCP) detects packet loss and performs retransmissions to ensure reliable messaging. Packet loss in a TCP connection is also used to avoid congestion and reduces throughput of the connection [27].

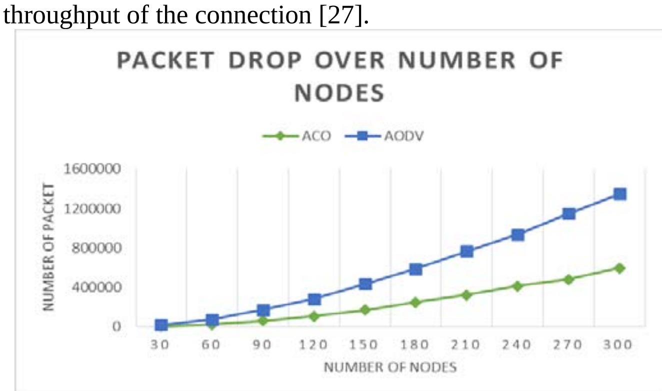

Figure 7 Packets Dropped

D. Throughput

Throughput or network throughput is the rate of successful message delivery over a communication channel. The data these messages belong to may be delivered over a physical or logical link, or it can pass through a certain network node. Throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second (p/s or pps) or data packets per time slot [8] [28].

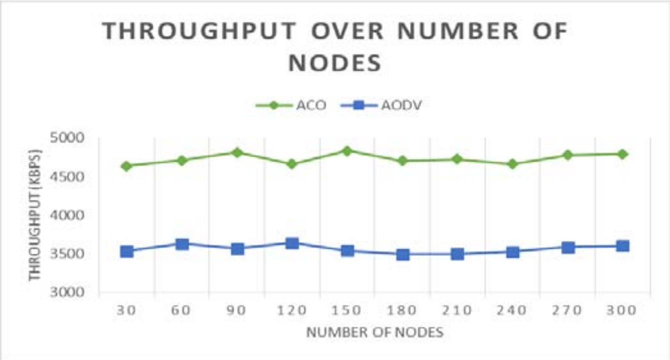

Figure 8 Throughput

VI. Conclusion

Finally, from the ACO is more efficient as compared to AODV in terms of QoS. And the results are: Latency (Average): ACO – 6038 (ms) & AODV – 5582 (ms) Overhead (Average): ACO - 6694 (bpp) & AODV – 14220 (bpp) Packet Drop (Average): ACO – 244371 (packets) & AODV – 578686 (packets) Throughput (Average): ACO – 4732 (KBPS) & AODV – 3567 (KBPS) This shows that after optimization with ACO on AODV time complexity increases but here time is not as important as Throughput. We could get a higher utilization by extending the size of the network. But that is not the point and is not our goal here.

Many challenges characterize the VANET routing research field, such as scalability redundant overhead, in adaptation to rapid topology changes, high exploration delay and so on. In this paper, for the purpose of solving mentioned issues, we propose opportunistic routing protocols in urban scenarios to establish the best route owning the best QoS in terms of throughput, overhead ratio, packet drop and average latency, we regard the routing issues as combinatorial nonlinear optimization problems the propose the ACO-based algorithms to resolve them.

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