Emergency Automobile Data Transmission with Ant Colony Optimization (ACO)

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***Abstract*—Vehicular Adhoc Networks (VANET) have grown in popularity recently. Several analytical challenges must address to build VANETs that improve driver assistance, safety, and traffic management. Another big problem is the development of expandable route findings that can assess fast topography variations and numerous network detachments brought on through excellent vehicle quality. This paper will first discuss extensive technological investigations comprising and defects of the current progressive routing algorithms. Then, author suggests an entirely original routing theme called Emergency Data Transmission using ACO (EDTA). Design this protocol to use any freeway the ambulance driver has access to or any less-traveled paths with the least amount of communication overhead and delay and the highest amount of communication throughput. The patients received treatment more promptly since the driver was alerted earlier. Author developed a novel fitness function for the Ant Colony Optimization (ACO) that concentrates on two crucial vehicle parameters: current travel speed and data/network congestion. The ACO is used to optimize to identify a more stable and reliable channel that enables rapid communication between vehicles. The performance of this protocol will compare to that of a state-of-the-art protocol in conclusion with "average throughput", "packet delivery ratio", "communication overhead", average delay, received packets, and other metrics.**

***Keywords*—emergency automobile, internet of things, vehicular base ant colony optimization, vehicular adhoc networks, evaluation metrices**

I. INTRODUCTION

Gridlock, accidents, fuel waste, and the loss of valuable lives are all caused by the rapid development of automobiles and the unpredictable behavior of drivers on the road, making the current transportation framework wasteful. Therefore, a new study area called "intelligent transportation" is recommended to solve these problems. It combines several encouraging advances in engine mobility and transportation frameworks to improve transportation safety and viability, vehicle control, and the distribution of the most recent portable administrations and solutions for on-street congestion via the board framework [1–3]. Effective Wireless Local Area Network (WLAN) upgrade planning to enable the development of highly-equipped networks for vehicles (VANETs).

Vehicular Ad Hoc Networks (VANETs) are a specific category of Mobile Ad Hoc Networks (MANETs). Compared to MANETs, cars may change geography quickly and powerfully because of their quick movement. Future vehicle hubs could also have longer transmission ranges, more installed storing and detection capabilities, and battery-powered fuel sources. VANETs, unlike MANETs, have a multitude of influence and handling abilities, making them more versatile and capable of doing computationally escalating tasks [4–7]. The possibility of providing security-related data to automobiles is the driving force behind the use of VANETs. Cars exchange status data, such as speed, acceleration, and position, via periodic messages known as "signals" to increase awareness of surrounding vehicles, increase security, and prevent collisions [8–10].

VANET has numerous highlights distinguish it from different portable impromptu organizations (MANET). These highlights incorporate the rapid development of hubs, tremendous organizations, and restricted versatility because of street geography. For example, geography-based MANET steering conventions (for example, Ad-hoc On-demand Distance Vector (AODV) [11], Optimized Link State Routing Protocol (OLSR) [12], and Dynamic Source Routing (DSR) [13]) work less productively in VANET [14, 15]. These steering conventions use broadcast components to discover and oversee courses. Notwithstanding, in VANET, the development of vehicles frequently prompts the interference of communication channels between vehicles. This association disappointment will increase the overhead of transmission control and directing and will likewise prompt the deficiency of convention execution.

The AODV calculation depends on the Bellman-Ford calculation as Destination Sequenced Distance Vector (DSDV). The hub is quiet until it has information to send. At the point when the upper layer then demands steering for the information bundle, it will be this case. The

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ROUTE REQUEST parcel is shipped off the climate. On the off chance that the neighbor has a course coordinating with the solicitation, it will return a ROUTE RESPONSE parcel. Something else, each neighbor will send a ROUTE REQUEST to its neighbor rather than the sender and increase the bounce worth of the bundle. They likewise utilize this parcel to make a return course passage (to the sender) [16]. This course discovered that AODV has unicast, broadcast, and multicast correspondence and is an on-request, low-dormancy route. Due to the utilization of chronic numbers, all courses have no circles. AODV utilizes chronic numbers to follow the precision of data. It just tracks the following bounce of the course, not the whole course. Moreover, the objective chronic numbers utilize to track down the furthest down the line course to the objective. There is less postponement in building up an association. One of the burdens of this convention is that if the first succession numbers are old and they have higher objective grouping numbers; however, the most recent; then, halfway hubs may cause conflicting steering at that point, so they have lifeless passages.

A Reliable Path Selection and Packet Forwarding Routing Protocol (RPSPF) [17] emphasizes dynamic systems used to identify the various intersections and constraints of the only convergent selection tool related to urban climate. He introduced a new route plan for the urban climate, which depends on different intersection systems and chooses the best path forward. The route to the destination depends on the ideal distance and traffic. As far as authors know, this is the first attempt to solve various steering problems based on a well-thought-out definition of intersection. They investigated and contemplated employing existing methods (TFOR (Traffic Flow-Oriented Routing), GPSR (Greedy Perimeter Stateless Routing), and GSR (Global State Routing)) and a test system to show our control approach. The rebalancing findings demonstrate that the RPSPF has advantages over current protocols such as TFOR, GPSR, and GSR regarding packet transmission.

Vehicular Routing Protocol Based on Ant Colony Optimization (VACO) [18] is a naturally enlivened strategy dependent on the ACO calculation for adding traffic attention to the notable GSR convention. In the created steering convention, the organization hubs get the essential traffic data in any capacity without requiring committed centers or controls, for example, traffic sensors, RSUs, or outside data streams. Moreover, the understanding adjusts to traffic conditions because the pheromone affidavit and dissipation component guarantees that the arrangement can adjust to changes in rush hour gridlock.

In this paper, we analyze the emergency data transmission using ACO routing protocol along with RPSF and VACO and discuss which routing protocol is most efficient for emergency transformation. Section II compares survey documents related to data transmission routing protocols. Section III will explain how the emergency data transmission using ACO works along with the mathematical model. The performance analysis compares parameters such as packet delivery ratio, average throughput, communication overhead, average delay, and packet loss for three scenarios in Section IV. Finally, Section V concludes the paper.

II. Literature Survey

A modern simulation environment that can run simulations consistently and efficiently must be used to evaluate performance. For the VANET research community, the ONE simulator provides the most versatile and reliable simulation environment [19, 20]. All of the researchers in the present investigation utilized the same simulation software for their simulations. The mobile model employed in VANET performance evaluation is another significant factor. Simulation of Urban MObility (SUMO) [21, 22] is a package for microscopic traffic simulation SUMO's moving lanes encompass all of the significant aspects of the urban environment. Key performance indicators and varied data were collected and displayed in this study. Existing routing systems for ad hoc cellular networks included DSR [13], AODV [23], and OLSR [24]. The routing technique considers the mobile node's direction by determining and maintaining the point-to-point routing track among the origin andterminal nodes [25, 26].

Improved Greedy Traffic Aware Routing Protocol (GyTAR) [14] creates with the urban environment in mind. It works on three levels: a) an intersection selection method; b) a traffic information system that does not require any infrastructure, and c) faster forwarding at greedy intersections, assigning a weight to each adjacent intersection. The packet route to the destination defines as the next intersection. When low traffic density, the intersection’s final selection mechanism conforms to the local optimum in the urban context, lowering its performance [1].

GyTAR has improved with EGyTAR (Efficient Greedy Traffic Aware Routing Protocol) [1]. On multi-lane roads, choose crossroads established on movement direction. It consists of two mechanisms: (i) cross-point selection and (ii) a greedy directional relay method that uses mobile data to decide the position of the object node. The intersection is chosen based on the movement volume and the direct route to the target. To forward packets among intersections, use greedy directed forwarding.

The Traffic Flow Oriented Routing Protocol (TFOR) [11] is a recently developed method that comprises two modules: (a) a traffic flow and shortest path route selection mechanism using intersection; and (b) a two-hop strategy. It determines the shortest ideal path based on the shortest range between the sender and receiver nodes.

The GPSR [27] algorithm creates to solve the highway routing problem. The greedy module and the peripheral module are the two modules that make up this system. The transmitting node in the greedy module passes the data packet to one of its one-way neighbors, the nearest one of its one-way neighbors, and then to the target [28]. The greedy module reaches a regional best when the packet's host does not have a one-way neighbor who is near to the target than it is. Graphic polarization and the right-hand rule are two mechanisms included in the perimeter module. Because of peripheral modules, data packets being sent from the origin to the target take a long time.

A-Star (ASTAR) [29] is a routing protocol that is aware of flow. It has two essential traits, to begin with: On the one hand, it uses statically classified maps to find a route with a significant number of cars. The second step is to help in solving the regional feasible solution challenge. In addition, it has a new local recovery approach [14] that outperforms GSR and GPSR.

GSR [30] is a routing technique created with metropolitan situations in mind. The quickest path that GSR can find using a digital map comprises a series of intersections, which the package goes through on its way to the destination. Fast forwarding utilize to send the data packet to its target. GSR ignores traffic density between intersections while calculating the quickest route.

GyTAR, EGyTAR, and TFOR are examples of these accords. These routing techniques dynamically select an intersection based on traffic density and the shortest length to the target when the data packet transfers to the destination. On the other hand, its selection process is a dynamic single-hop crossover point. Therefore, they do have certain limitations.

VANET can employ in two separate settings: cities and highways. Intersections make up the metropolitan landscape. An intersection is a point where two or more streets meet. The highway environment, on the other hand, is devoid of obstacles. In an urban environment, different intersection sequences might play a crucial role in ensuring the shortest distance between the start and end places [21, 31].

Most of the protocols mentioned (such as AODV, DSR, OLSR, GPSR, GSR, ASTAR, GyTAR, EGyTAR, and TFOR) [14, 15, 32–36] do not consider traffic density when routing. However, traffic density is an essential source of connectivity. The protocol routes the data packets to the destination through-traffic density or connection of lower city streets. Therefore, the data packet usually matches the local optimum, which causes the data packet transmission rate to slow. Immediately inform us of traffic jams on the city streets. The agreement finally determines the band that causes the optimal local problem, regardless of whether an influential band can overcome it [37–41]. When the data packet is re-transmitted from the origin to the target, the possibilityof packet loss increases and becomes invalid.

Use biological heuristics to optimize the advantages of ant colonies for cross-company communication. There are multiple protocols for automotive networks, so it is not easy to choose a protocol for them. The tasks suggested above aim at improving system performance or saving energy. However, here author focuses on obtaining information about the target vehicle [18, 42]. The evaporation and repositioning of pheromones give high priority, so there is no cyclic dependency affecting the system, thus avoiding the same path they had taken before. Fig. 1 shows the classification of the different routing protocols.

This paper's main contributions are as follows:

- To formulate the problem of path clearance for ambulances using reliable and fast routing
- To design the consolidated framework to automatically suggest the freeways to ambulance drivers using robust and reliable data communication.
- To propose an improved ant colony optimization-based VANET data transmission algorithm that considers mobility and network constraints.
- To use cutting-edge technology to model, simulate, and evaluate the proposed contributions.

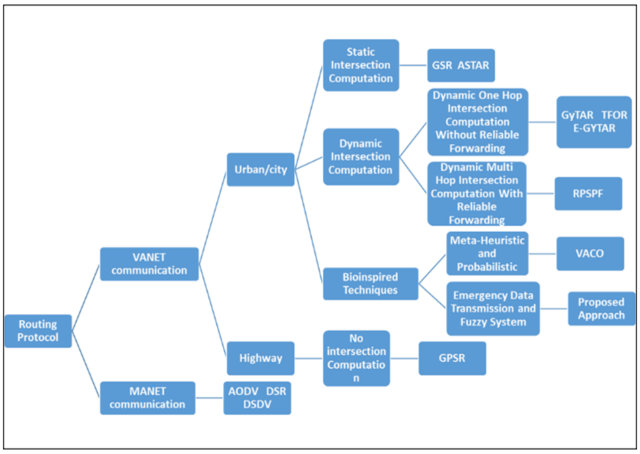

Figure 1. Classification of different routing protocols.

III. Emergency Data Transmission Using ACO (EDTA©)

Author will design this protocol to perform the freeway available or paths with less traffic available to the ambulance driver with minimum communication delay and overhead and maximum communication throughput. The earlier alert to the driver leads to faster treatment for the patients. Author designed the ACO with a novel fitness function that focuses on two significant parameters of vehicles, such as current moving speed and data/network congestion. The ACO was applied to discover a more robust and reliable path that allows fast communications among vehicles through optimizations.

Each street section between two junctions is evaluated by EDTA using ACO in terms of latency, bandwidth, and delivery ratio. It is believed that an RSU exists at each junction to store routing data and determine packet routes. To establish a route, the source node directs numerous ants towards a target RSU that is closest to the destination vehicle. In the target RSU, backward ants are produced and sent back to the source. The EDTA adopts a proactive strategy for route maintenance. Employing RSU at every junction can be costly and might not be realistic, at least during the first rollout of VANET.

Algorithm 1: Pseudo code shows the working of the proposed EDTA protocol where the vehicle speed, traffic at a node, and distance-based routes construct from each pair $E^i - D^i$.

Algorithm 1: Pseudo code: Emergency Data Transmission Using ACO

Inputs
E: $emergency\ data\ transmission\ vehicles$
D: $corresponding\ destination\ vehicle$
nb: $Set\ of\ neighbouring\ nodes$
$temp$: $temperory\ Vehicle$
t: $Current\ simulation\ time$
P: $number\ of\ iterations$
RT: $Initial\ pheromone\ value$
Output:
$Reliable\ Emergency\ Data\ Transmission$

1. While (P)
2. For each E
3. $temp = E$
4. Ediscovers the neighbouring nodes nb
5. Broadcast FANT's $FA^i \in FA$ for each $N^i \in nb$
6. For each N^i of , upon receiving FA^i
7. $speed^i = getVelocity\ (N^i)$
8. $traffic^i = getTraffic\ (N^i)$
9. $distance^i = getDist\ (NV^i, N^i)$
10. $f^i = getFitness(speed^i, traffic^i, distance^i)$
11. $F(i) \leftarrow f^i$
12. End For
13. $temp = \max\ (F)$
14. If $(temp \neq D)$
    - 14.1. forward (temp, FA)
    - 14.2. Update pheromone value i.e. RT
    - 14.3. Go to step 3
15. Else
    - 15.1. Construct the reveres ant i.e. BA and discover the route RT
    - 15.2. Update pheromone value i.e. RT
    - 15.3. Data transmission begins
16. End if
17. End For
18. End While

As shown in Algorithm 1, the fitness function computes using three key parameters: node velocity, node traffic, and distance. $getVelocity\ (N^i)$ function computes the velocity of i^{th} ant node as:

$$speed^i = 1 - \left(\frac{mobility(N^i,t)}{150}\right) \tag{1}$$

where $mobility(N^i, t)$ returns the current moving speed of a vehicle at time t.

For emergency data transmission, traffic awareness is also important. Thus we included the traffic parameter of the next node for fitness computation. $getTraffic\ (N^i)$ returns the level of traffic of $the\ i^{th}$ ant node as:

$$traffic^i = \frac{recvACK(E,N^i)}{genHello(E,N^i)} \tag{2}$$

where $recvACK(E, N^i)$ denotes the number of received ACK at current emergency data transmission node E, and $recvHello(E, N^i)$ generates the number of HELLO packets from E to N^i.

The $getDist\ (NV^i, N^i)$ computes the geographic distance between NV^i to N^i. The distance computes by utilizing their current positions in the network. The RSSI values provide the positions. The $distance^i$-based trust score for node N^i computes as follows:

$$r^1 = getRSSI(NV^i) \tag{3}$$

$$r^2 = getRSSI(N^i\ ) \tag{4}$$

$$distance^i = 1 - \frac{|r^2 - r^1|}{\left(\frac{(X+Y/2)}{2}\right)} \tag{5}$$

where X is the height, Y represents the width of the VANET network, and the outcome value in $distance^i$ is 0 to 1. The higher the $distance^i$ value of node N^i, the better the chance of becoming the next forward node.

The final fitness value computed as

$$f^i = \Big((w^1 \times speed^i) + (w^2 \times traffic^i) + (w^3 \times distance^i)\Big) \tag{6}$$

The w^1, w^2, & w^3 are weight factors that transform the value of the trust score between 0 to 1. The selection of these values should satisfy the condition of $w^1 + w^2 + w^3 = 1$. For this work, we prioritize these values as $w^1 = 0.4,\ w^2 = 0.4, \&\ w^3 = 0.3$.

IV. Simulation Results

Adhoc On-Demand Distance Vector Routing (AODV) and Dynamic Multi-Hop Intersection Computation with Reliable Path Selection and Packet Forwarding (RPSPF) are two On-Demand (Reactive) routing protocols. Emergency Data Transmission (EDTA) and VANET routing protocols based on ant colony optimization (VACO) use. The Random Walk Mobility Model use because it simulates the random movement of mobile vehicle nodes. All the simulation parameter is in Table I.

TABLE I. Simulation Parameter

Parameter	Value (Scenario 1)	Value (Scenario 2)	Value (Scenario 3)
Vehicle Density	50, 100, 150, 200, 250, 300	100	100
Ambulance Moving	5	5	5
Simulation Time(s)	300	300	80, 90, 100, 110, 120, 130
Mobility (Km/h)	40	45, 50, 55, 60, 65, 70	45
Routing Protocol	AODV, RPSPF, VACO, EDTA	AODV, RPSPF, VACO, EDTA	AODV, RPSPF, VACO, EDTA
MAC(p)	802.11	802.11	802.11
Propagation Model	Two-Ray Ground	Two-Ray Ground	Two-Ray Ground
Area	7000×7000	7000×7000	7000×7000
Mobility	Random Walk	Manhattan grid mobility Model	Random Walk
Antenna	Omni Antenna	Omni Antenna	Omni Antenna
Traffic Model	CBR	CBR	CBR

Scenario 1: In this scenario, the number of nodes connected in a network at any time modifies, hence modifying the number of connections from which the AODV, RPSPF, VACO, and EDTA comparative graphs creates. The result for all parameter is shown in Table II.

Average Throughput: The comparison of the AODV, RPSPF, VACO, and EDTA shows in Fig. 2. The graph demonstrates that the EDTA has a higher average throughput than the others. The average throughput falls as the number of nodes grows.

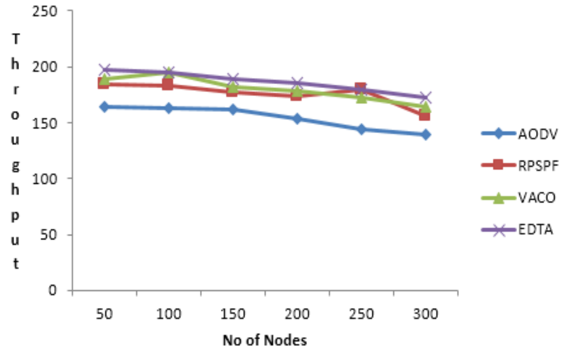

Figure 2. Average throughput for AODV, RPSPF, VACO, and EDTA.

TABLE II. QOS PARAMETER FOR SCENARIO 1

Qos Parameter	No of Nodes	AODV	RPSPF	VACO	EDTA
PDR	50	86.24	94.56	95.87	98.28
	100	80.54	88.91	92.45	92.45
	150	78.37	86.76	88.08	90.29
	200	76.09	84.39	85.70	87.91
	250	71.25	85.69	84.19	85.69
	300	65.95	77.37	80.74	82.80
Average Throughput	50	164.5	184.4	189.1	197.4
	100	162.8	182.6	194.8	194.8
	150	161.6	176.8	181.2	188.9
	200	154.0	173.2	177.7	185.1
	250	143.6	179.8	172.9	179.8
	300	138.9	155.7	164.1	172.6
Communication Overhead	50	0.21	0.19	0.17	0.16
	100	0.45	0.41	0.34	0.34
	150	2.75	2.48	2.28	2.08
	200	4.12	3.53	3.21	3.03
	250	6.21	4.25	4.50	4.25
	300	8.01	6.80	6.07	5.67
Average Delay	50	0.05	0.05	0.05	0.05
	100	0.12	0.11	0.11	0.11
	150	0.17	0.16	0.16	0.15
	200	0.19	0.19	0.19	0.18
	250	0.21	0.19	0.14	0.19
	300	0.32	0.28	0.23	0.21
Packet Loss	50	200	079	060	025
	100	281	160	109	109
	150	312	191	172	140
	200	347	226	207	175
	250	422	210	232	210
	300	495	329	280	250

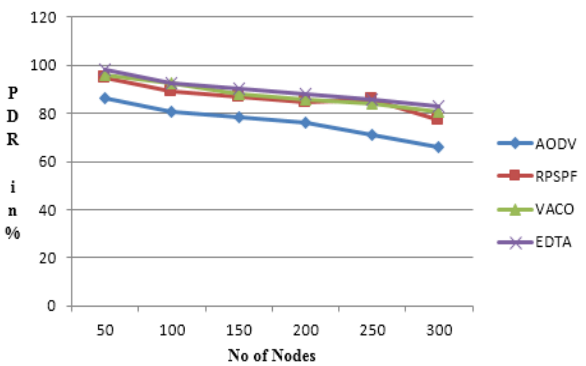

Figure 3. PDR for AODV, RPSPF, VACO, and EDTA.

PDR: The comparison of the AODV, RPSPF, VACO, and EDTA shows in Fig. 3. The graph demonstrates that the EDTA has a higher packet delivery ratio than the others. The packet delivery ratio falls as the number of nodes grows.

Communication Overhead: The comparison of the AODV, RPSPF, VACO, and EDTA shows in Fig. 4. The graph illustrates that the EDTA has a lower communication overhead than the others. As the number of nodes grows, so does the amount of communication overhead.

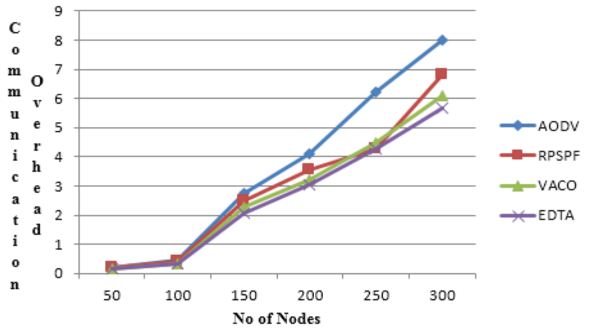

Figure 4. Communication overhead for AODV, RPSPF, VACO, and EDTA.

Average Delay: The comparison of the AODV, RPSPF, VACO, and EDTA shows in Fig. 5. The graph illustrates that the EDTA has a shorter average delay than the others. The delay grows as the number of nodes increases.

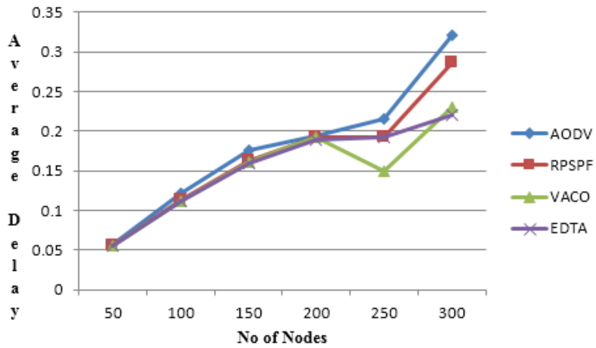

Figure 5. Average delay for AODV, RPSPF, VACO, and EDTA.

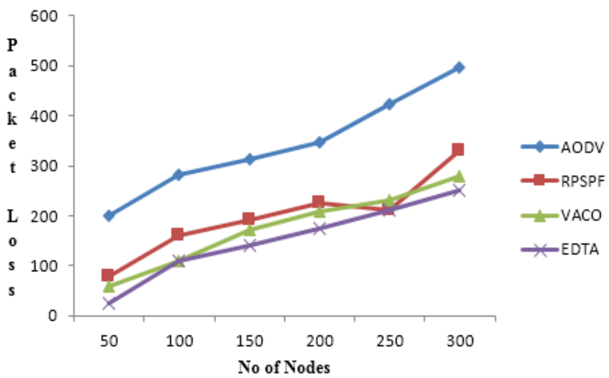

Figure 6. Packet loss FOR AODV, RPSPF, VACO, and EDTA.

Packet Loss: The comparison of the AODV, RPSPF, VACO, and EDTA shows in Fig. 6. As shown in the graph, the packet loss for the EDTA is less than for the others. However, the packet loss increases as the number of nodes increases.

Scenario 2: In this scenario, the total number of vehicle nodes in the network at any given time remains constant, as does the pace at which they move in a 7000×7000 meter network, which use to generate the AODV, RPSPF, VACO, and EDTA comparative graphs. The result for all parameter is shown in Table III.

TABLE III. QOS PARAMETER FOR SCENARIO 2

Qos Parameter	Speed of Nodes km/hr	AODV	RPSPF	VACO	EDTA
PDR	45	78.38	85.30	86.96	88.56
	50	76.78	83.80	85.49	87.11
	55	73.28	80.26	82.22	84.82
	60	66.10	73.10	76.51	79.69
	65	63.72	70.65	72.89	77.19
	70	57.34	64.36	67.20	73.30
Average Throughput	45	188.8	210.0	217.3	225.4
	50	183.4	204.0	211.1	218.9
	55	177.5	197.5	204.4	211.9
	60	165.5	178.3	186.3	197.8
	65	162.3	174.9	182.7	193.9
	70	148.7	163.0	169.3	181.6
Communication Overhead	45	3.44	3.31	3.04	2.90
	50	3.78	3.59	3.21	3.03
	55	5.10	4.90	4.50	4.21
	60	7.55	6.63	5.79	5.24
	65	11.63	10.72	9.29	8.19
	70	16.18	14.75	12.86	11.14
Average Delay	45	0.24	0.22	0.20	0.18
	50	0.25	0.24	0.23	0.22
	55	0.30	0.27	0.46	0.42
	60	0.43	0.41	0.40	0.39
	65	0.61	0.59	0.57	0.54
	70	1.11	1.07	1.04	0.95
Packet Loss	45	378	257	228	200
	50	400	279	250	222
	55	463	342	308	263
	60	586	465	406	351
	65	633	512	473	398
	70	735	614	565	460

Average Throughput: The comparison of the AODV, RPSPF, VACO, and EDTA shows in Fig. 7. The graph demonstrates that the EDTA has a higher average throughput than the others. However, the average throughput falls as the number of nodes grows.

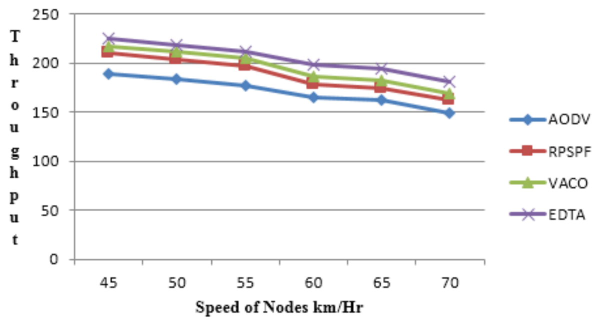

Figure 7. Average throughput FOR AODV, RPSPF, VACO, and EDTA.

PDR: The AODV, RPSPF, VACO, and EDTA are all compared in Fig. 8. The graph demonstrates that the EDTA has a higher packet delivery ratio than the others. The packet delivery ratio falls as the number of nodes grows.

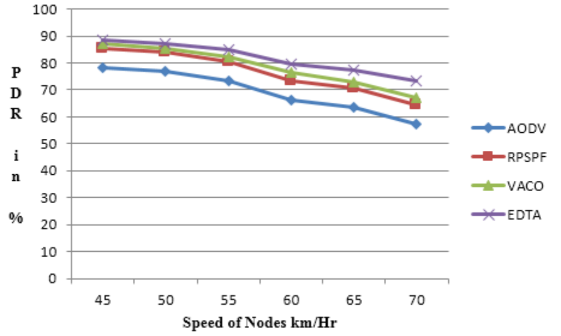

Figure 8. PDR for AODV, RPSPF, VACO, and EDTA.

Communication Overhead: The comparison of the AODV, RPSPF, VACO, and EDTA shows in Fig. 9. The graph illustrates that the EDTA has a lower communication overhead than the others. As the number of nodes grows, so does the amount of communication overhead.

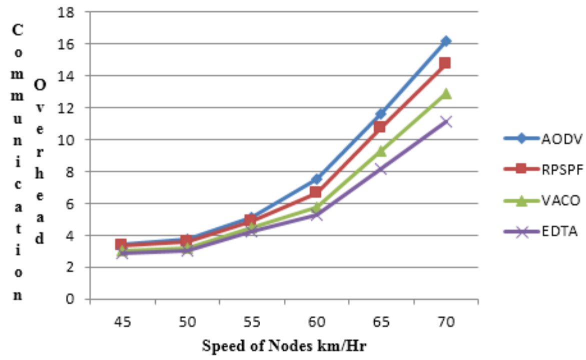

Figure 9. Communication overhead FOR AODV, RPSPF, VACO, and EDTA.

Average Delay: The comparison of the AODV, RPSPF, VACO, and EDTA shows in Fig. 10. The graph illustrates that the EDTA has a shorter average delay than the others. The delay grows as the number of nodes increases. However, the delay for node 60 is decreasing, again in ascending order.

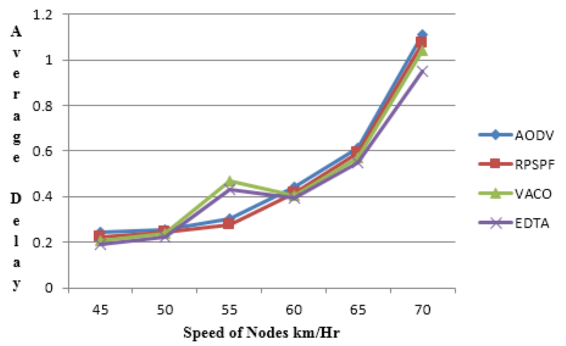

Figure 10. Average delay FOR AODV, RPSPF, VACO, and EDTA.

Packet Loss: The comparison of the AODV, RPSPF, VACO, and EDTA shows in Fig. 11. As shown in the graph, the packet loss for the EDTA is less than for the others. However, the packet loss increases as the number of nodes increases.

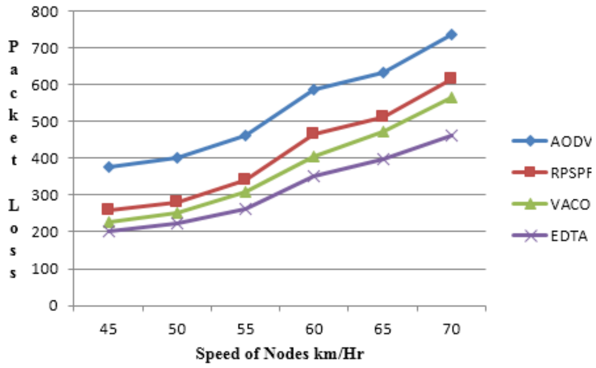

Figure 11. Packet loss FOR AODV, RPSPF, VACO, and EDTA.

Scenario 3: In this scenario, the total number of vehicle nodes in the network remains constant at 100 while the speed remains constant at 45 km/h, altering the simulation time of the network and yielding the AODV, RPSPF, VACO, and EDTA comparative graphs.

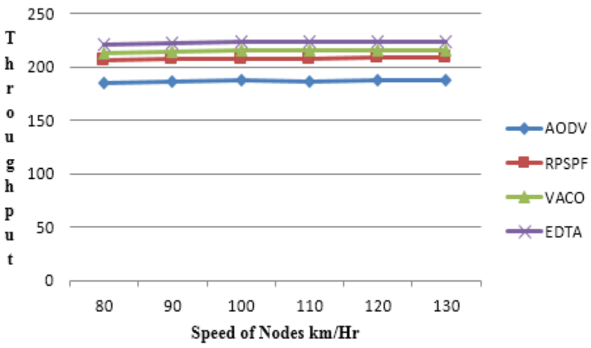

Figure 12. Average throughput FOR AODV, RPSPF, VACO, and EDTA.

Average Throughput: The AODV, RPSPF, VACO, and EDTA shows in Fig. 12. The graph demonstrates that the EDTA has a higher average throughput than the others. The average throughput falls as the number of nodes grows.

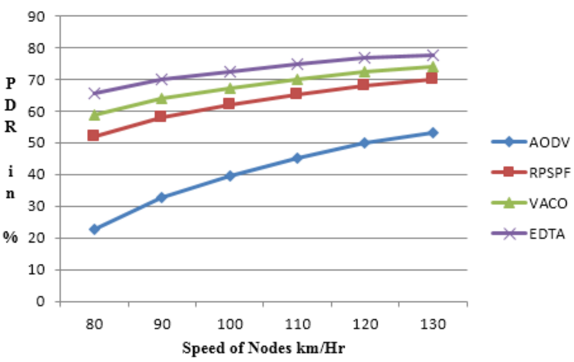

Figure 13. PDR for AODV, RPSPF, VACO, and EDTA.

PDR: The comparison of the AODV, RPSPF, VACO, and EDTA shows in Fig. 13. The graph demonstrates that the EDTA has a higher packet delivery ratio than the others. The packet delivery ratio falls as the number of nodes grows.

Communication Overhead: The comparison of the AODV, RPSPF, VACO, and EDTA shows in Fig. 14. The graph illustrates that the EDTA has a lower communication overhead than the others. As the number of nodes grows, so does the amount of communication overhead.

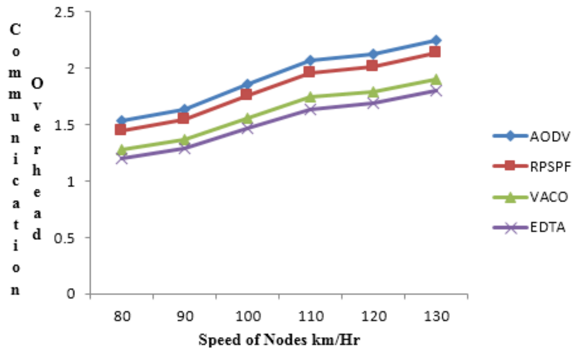

Figure 14. Communication overhead for AODV, RPSPF, VACO, and EDTA.

Average Delay: The comparison of the AODV, RPSPF, VACO, and EDTA shows in Fig. 15. The graph illustrates that the EDTA has a shorter average delay than the others. The delay grows as the number of nodes increases. However, the delay for node 60 is decreasing, again in ascending order.

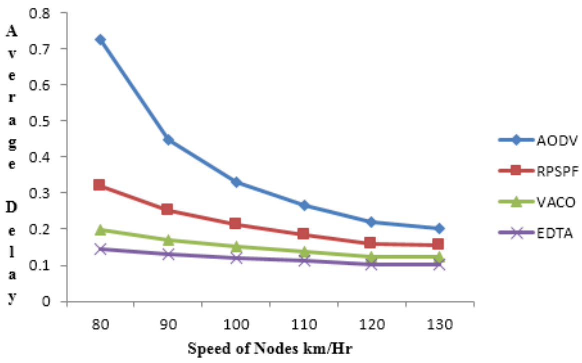

Figure 15. Average delay FOR AODV, RPSPF, VACO, and EDTA.

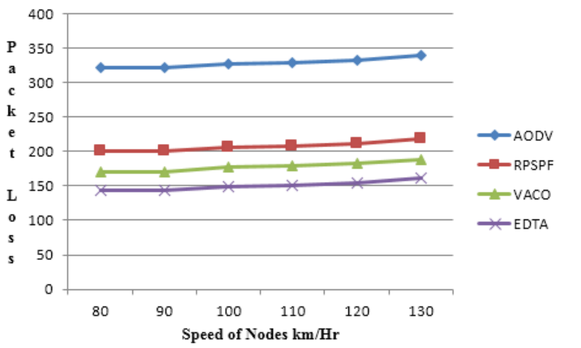

Figure 16. Packet loss for AODV, RPSPF, VACO, and EDTA.

Packet Loss: The comparison of the AODV, RPSPF, VACO, and EDTA shows in Fig. 16. As shown in the graph, the packet loss for the EDTA is less than for the others. However, the packet loss increases as the number of nodes increases.

Based on theoretical research, the paper compares practical methods for emergency data transmission based on routing protocols, and the simulation findings agree. NS2.34 was used to build the various situations. We simulate for 300 s and save the graphs in the trace file for analysis and calculation. Certain graphs help analyze the performance of these routing methods statistically. The appropriate graphs save as bitmap images for statistical analysis.

The first scenario executes, and a trace file creates. The car nodes in this scenario simulate CBR traffic applications using Ad-hoc On-Demand Distance Vector (AODV), RPSPF, VACO, and EDTA. Various characteristics like Packet Delivery Ratio, Average Throughput, Communication Overhead, Average Delay, and Packet Loss examine.

Packet Delivery Ratio: In this statistic, EDTA surpasses RPSPF, VACO, and AODV. The PDR grows as the number of nodes increases, as seen in Fig. 3. Average Throughput: EDTA outperforms RPSPF, VACO, and AODV in terms of throughput. It can be seen in Fig. 2 that as the number of nodes rises, the average throughput falls. Communication Overhead: EDTA performs worse than RPSPF, VACO, and AODV. EDTA's performance is inferior to that of RPSPF, VACO, and AODV. As seen in Fig. 5, the average latency increases as the number of nodes grow. Packet Loss: As seen from the graph, the EDTA has a lower packet loss than the others. Because the number of nodes rises, the packet loss also increases.

V. Conclusion

Because of its capacity to sustain connections through the periodic exchange of information required by TCP networks, EDTA performs well. EDTA beats all others in terms of packet delivery ratio and average throughput. EDTA beats others in terms of packet delivery ratio and throughput. However, AODV exceeds others regarding communication overhead, average delay, and packet loss. At increasing node mobility, EDTA performs worse in terms of packet loss and communication overhead but best in terms of packet delivery ratio.

Regarding higher node mobility, AODV outperforms RPSPF and VACO in the packet loss situation. As a result, EDTA recommends VACO and AODV for real-time traffic. Finally, EDTA offers the best results based on the previous research findings.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

C. H. Nemade wrote the manuscript with support from Uma Pujeri. C. H. Nemade developed the theoretical formalism, performed the analytic calculations, and performed the numerical simulations. Both C. H. Nemade and Uma Pujeri contributed to the final version of the manuscript. Uma Pujeri supervised the research work. Both authors had approved the final version.

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