Enhancing Service Excellence in Vehicular Ad Hoc Networks (VANETs)

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***Abstract*- Vehicular Ad hoc Networks (VANETs) depend on Quality-of-Service (QoS) protocols to guarantee timely and dependable data exchange between vehicles and with infrastructure. In intelligent transportation systems, VANETs are essential for improving traffic control, passenger convenience, and road safety. An extensive examination of QoS protocols designed specifically for VANETs is given in this paper. It explores the difficulties particular to this fast-paced, dynamic environment, gives a summary of current protocols, and points out areas in need of development. This research helps to effectively deploy intelligent transportation applications by addressing QoS issues in VANETs. NS2 and an open street map were used in VANET to evaluate the AODV and DSDV protocols. When packet success and throughput were assessed in actual traffic situations, vehicle-to-vehicle communication performance improved.**

***Keywords*- Vehicular Ad hoc Networks (VANETs), Quality-of-Service (QoS) protocols, Intelligent Transportation Systems, AODV and DSDV protocols, Network Simulation (NS2).**

I. INTRODUCTION

Vehicular Ad hoc Networks (VANETs) are necessary criteria of today's intelligent transportation environment, facilitating different types of uses through vehicle-to- vehicle (V2V) and vehicle-to-infrastructure (V2I) communication. Vehicle nodes are constantly moving through the network, giving VANETs their dynamic and quickly changing nature. It is extremely difficult to ensure Quality of Service (QoS) in such an environment. Applications like data innovation administrations, traffic advancement, and security cautions are made conceivable by QoS conventions in VANETs. This paper presents a thorough analysis of QoS protocols designed with VANETs in mind. To meet the strict QoS requirements of VANET applications, the research aims to clarify their significance, evaluate current solutions, and identify areas that need more investigation and development. In order to improve packet delivery ratio, data throughput, and packet delivery latency in vehicular ad hoc networks (VANETs), a potential routing method is required.

By altering current AODV protocol, the authors suggest an enhanced Ad Hoc on Demand Distance Vector (ENAODV) routing system. Using node identity and real-time location data, the ENAODV integrates a node trend prediction technique. The efficacy of AODV and DSDV protocols in VANETs using NS2 and OpenStreetMap, aiming to enhance vehicle-to-vehicle communication for real-time traffic data exchange, improving road accuracy and planning.

In Vehicle-to-Vehicle - V2V and vehicle-to-side of the road foundation - V2I networks, vehicles act as mobile nodes. VANETs are a specific kind of Mobile Ad-hoc Network (MANET). These networks are essential for applications in traffic control, smart transportation, and road safety. VANETs are different from other wireless network domains in that they operate in high-mobility environments, which presents unique challenges. In order to optimise network layer parameters and improve packet delivery ratio, data throughput, and packet delivery latency, vehicular ad hoc networks need an effective routing strategy that can be applied to any arbitrary vehicle movement. In order to provide a new routing system for VANETs, this article modified the widely used AODV protocol to create Enhanced AODV (ENAODV).

The provision of Quality-of-Service (QoS) in Vehicle Ad hoc Networks (VANETs) is the issue this study attempts to solve. Because VANETs are dynamic and constantly changing due to the moving vehicles, network connectivity is unpredictable. Furthermore, there are strict QoS requirements regarding bandwidth allocation, low latency, and reliable data delivery for VANET applications like traffic management and safety critical warnings. In order for VANETs to live up to their promise of improved traffic optimization and road safety, it is essential that efficient QoS protocols be created specifically for this environment. Therefore, in order to contribute to the dependable operation of VANET applications, this research intends to investigate current QoS protocols, evaluate their applicability in the context of VANETs, and pinpoint areas for improvement. The proposed strategy, named Enhanced AODV (ENAODV), modifies the existing AODV protocol.

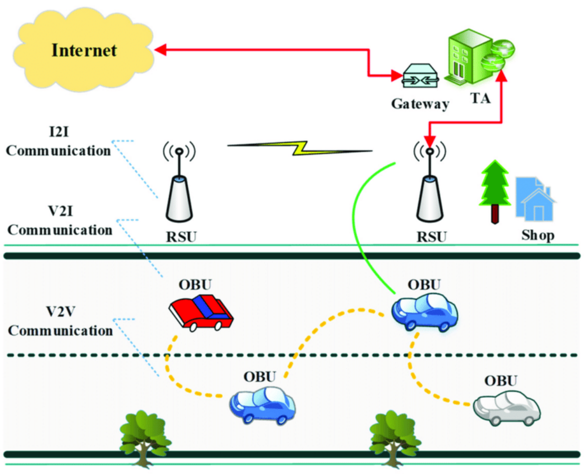

Figure 1: Generic Architecture of VANET

II. LITERATURE SURVEY

Akshat Srivastava [1] focuses on routing protocols (DIVERT, FBAODV, DSR) and congestion control, comparing their impact on network efficiency and throughput. Using route cache information, Dynamic Source Routing (DSR), an on-demand method, lowers network overhead. Also, it covers the Fitness-Based AODV (FBAODV) protocol, which forms networks and evaluates quality of service using Received Signal Strength Indicator (RSSI). It concludes that although VANET has attracted a lot of interest for its use in collision avoidance and real-time traffic monitoring, it still has issues with network outages and mobility that compromise Quality of Service (QoS). Mohammad Javad Sayadi [2] It presents a novel approach for enhancing the delivery and processing of critical messages in Vehicular Ad Hoc Networks. Related efforts have also looked into lowering network load and assessing message utility according to parameters such as message age and VANET has attracted a lot of interest for its use in collision avoidance and real-time traffic monitoring, it still has issues with network outages and mobility that compromise Quality of Service (QoS). geographical resolution. Several methods are used CBF algorithms, forwarding trajectories, and digital street maps for routing. This suggests an improvement in the transmission and processing of critical messages, which is essential for the efficiency and safety of traffic in VANETs. Wajahat Hussain [3] proposes a layered framework to enhance QoS, outperforming existing protocols. proposes mobile agents, adaptive modulation, and routing improvements to improve throughput, packet loss, and end- to-end delay in order to address QoS concerns in VANETs. The framework is validated by simulation results. prioritises adaptive modulation and message prioritization, simulates with NCTU, and uses deep classification. Simulation results show its superiority over existing routing protocols in improving QoS.

SABIH UR REHMAN [4] proposes cross-layer routing, and validates via simulations, emphasizing cross-layered approach for QoS in VANETs. Initially VANET routing was similar to MANETs, but it was eventually identified as distinct due to its predefined mobility patterns. Cross-layer routing, QoS, and QoE enhancements are noticed. Extensive simulations and analysis demonstrate its effectiveness. And also execute Monte-Carlo and extended simulations to analyse performance indicators. Gongjun Yan[5] introduces a routing protocol to improve Quality of Service (QoS) in Vehicular Ad-hoc Networks (VANETs). VANETs enhance communication for vehicles and infrastructure, but their high mobility makes maintaining reliable paths a challenge. The proposed protocol optimizes routing paths based on vehicle mobility, addressing QoS issues in VANETs.To reduce control message flooding, it selectively sends messages to maintain routes and employs local repair to replace broken links. Amir Javadpour[6] introduces With the Particle Swarm Optimization (PSO) technique, Vehicle Ad Hoc Networks (VANETs) can improve Quality of Service Routing (QoSR). Improved network performance is the goal of the PSO-based strategy, which optimizes packet delivery rates, delay, and packet drop. The study compares the PSO approach with current routing algorithms and conducts extensive simulations using NS2 and Vanet Mobisim. Findings indicate lower control overhead, better packet delivery, and decreased latency, which makes the PSO-based QoSR a viable option for VANETs. Madiha Shahzad[7] discusses Vehicular Ad-hoc Networks (VANETs) and 5G networks are integrated for better user experience and intelligent transportation.It emphasises the significance of Quality of Experience (QoE) and suggests a QoE model that makes use of NFV and SDN ideas. Along with discussing network simulations, subjective QoE assessment, and the possible application of VANET infrastructure as a 5G relay, the article also lists system influencing elements for objective QoE assessment. It also investigates a user incentive model for 5G-VANET scenarios' resource sharing. Ankita Srivastava[8] presents an Ant Colony Optimization (ACO)-based routing protocol called RDACO for Vehicular Ad-Hoc Networks (VANETs). Due to their massive network size, frequent disconnections, and quick topology changes, VANETs are difficult to use. Finding dependable routes that meet Quality of Service (QoS) requirements including stability and latency is the main goal of RDACO. According to simulation data, RDACO performs better than current protocols in means of delay and packet delivery ratio (PDR), particularly in crowded settings. A serious level of course disclosure reliability is guaranteed by the proactive development and support of courses by the convention. Saeed Tabar [9] focuses on the Quality of Service (QoS) in Vehicular Ad-hoc Networks (VANET) and compares two routing protocols, AODV and DSDV, in three different simulation scenarios. In Intelligent Transportation Systems, VANETs are essential, particularly for safety applications. In these settings, the study examines QoS metrics such overhead, packet loss, and delay. The findings reveal that the choice of routing protocol affects VANET QoS; AODV performs better in some cases while DSDV performs better in others, indicating the necessity of a position-based routing algorithm for enhanced QoS.support for smart devices in environments such as warehouses, universities, and hospitals where wired connections are impractical. K.R. Jothi[10] emphasizing factors like power conservation, process execution, and prioritizing life safety and text interactive communication in emergencies. In order to improve QoS metrics like packet loss and end-to-end delay in VANETs, these techniques include deploying mobile agents to optimise routing paths, adaptive modulation for increased throughput, opportunistic routing for trustworthiness, and MPLS for effective data forwarding. Carrying out performance analysis of various routing protocols using the NCTUns simulation tool. Bernhard Wiegel[11] addresses the problem of unscalable bandwidth consumption and redundant information broadcasting in vehicular ad hoc networks (VANETs) and presents a methodology for ensuring Quality of Service (QoS). In order to enhance QoS, maximize communication ranges, and identify redundant broadcasts, it suggests a spatial partitioning technique. The LDM-STREAM algorithm reduces channel congestion and coordinates data transmission by using signaling messages. The goal of this strategy is to lower bandwidth usage and improve data reliability, especially for continuous broadcasts of environmental data in VANETs. Sami Abduljabbar Rashid[12] discusses the challenges faced by VANETs, such as high energy consumption and link instability. It prevents duplication and fosters field advancement. And also examining data distribution strategies, talking about QoS protocols, evaluating VANET problems, and contrasting their effectiveness. Central questions are tended to by introducing recommended conventions, featuring execution assessment factors, and examining QoS and information dispersal in VANETs.

III. METHODOLOGY OF THE PROPOSED WORK

- QoS Requirements Analysis
- Traffic Classification
- Network Architecture
- SLAs and QoS Metrics
- Resource Allocation
- Monitoring and Management
- Security Measures
- AODV VS DSDV
- ENAODV

A. *Qos Requirements Analysis*

VANETs entails determining the unique requirements of different applications running in vehicular ad hoc networks. For every application category, specific parameters are identified, including minimal jitter, high throughput, low latency, and reliability. Infotainment services prioritize throughput, while safety systems require ultra-low latency and high reliability. Emergency services need ultra-low latency and low jitter, while traffic management depends on moderate latency and high throughput. Inside VANETs, proficient and fruitful correspondence is guaranteed by modifying QoS boundaries to these changed applications.

B. *Traffic Classification*

Network data is divided into several classes in Traffic Classification for VANETs according to the unique QoS requirements of each class. Need levels are appointed to each traffic class so crisis administrations and traffic the board start things out, trailed by essential security related messages. Applications that are less important, like infotainment, are given lower priority. By classifying and prioritizing network resources, this system improves overall efficiency and guarantees that critical safety communications are not missed.

C. *Network Architecture*

Roadside Units (RSUs), On-Board Units (OBUs), and V2V communication are all integrated into the proposed VANET architecture to form a comprehensive network. This architecture, which has specific channels for in-vehicle real- time communication, gives priority to important messages for increased safety. Additionally, it supports various traffic classes, allowing for effective data transfer for a range of applications. The system makes the best use of RSUs to transmit critical information to vehicles, and OBUs facilitate smooth data exchange and communication, resulting in a network architecture that is both resilient and flexible.

D. *SLAs and QoS Metrics*

For every traffic class, Service Level Agreements (SLAs) and Quality of Service (QoS) metrics are set in order to guarantee effective and dependable performance within the VANET. These agreements specify precise performance standards, catered to the particular needs of various vehicle application types, including latency, throughput, and reliability. The network can prioritize critical services, maintain consistent service quality, and offer a framework for performance monitoring and optimization across different traffic categories by setting different SLAs and QoS metrics.

E. *Resource Allocation*

Create resource allocation algorithms that are flexible in response to changing traffic conditions and quality of service demands. Cross-Layer Optimization:
Encourage cross-layer optimization in order to satisfy QoS demands. Network settings should be modified for particular applications.

This section examines the Quality-of-Service (QoS) specifications for different types of applications running on Vehicular Ad hoc Networks (VANETs). The precise QoS parameters found for every kind of application are listed in the below table:

Application Category:	***Qos Parameters:***
Infotainment Services	-High Throughput
Safety Systems	-Ultra-low Latency -High reliability
Emergency Services	-Ultra-low Latency -Low Jitter
Traffic Management	-Moderate Latency -High Throughput

Table 1: Qos Requirements Analysis

The AODV, DSDV, and ENAOVD routing protocols are compared in the following table, which also highlights their features in VANETs:

Routing Protocol:	***Characteristics:***
AODV	-Reactive Protocol. -On-Demand Route establishment. -Suitable for small to medium-sized networks. -Minimal control overhead.
DSDV	-Proactive Protocol -Regular updates to maintain route information. -Higher control overhead compared to AODV.
ENAOVD	-Modified AODV protocol with added functions. -Improved performance in real-world traffic. -Utilizes NS2 and OpenStreetMap for evaluation. -Acheives better Packet Delivery Ratio(PDR)

Table 2: AODV vs DSDV vs ENAOVD

IV. RESULTS

Results from the suggested design and analysis show the transmitter performs better in real-world traffic situations and highly changeable weather scenarios, making it a good fit for vehicle-to-vehicle communication. The comparison of the DSDV and AODV protocols will provide important information about which routing system is best for VANETs, taking into account the unique demands and difficulties of dynamic vehicular environments. After comparison we have come to an conclusion that AODV is best routing protocol than DSDV as it is shown in the graph.

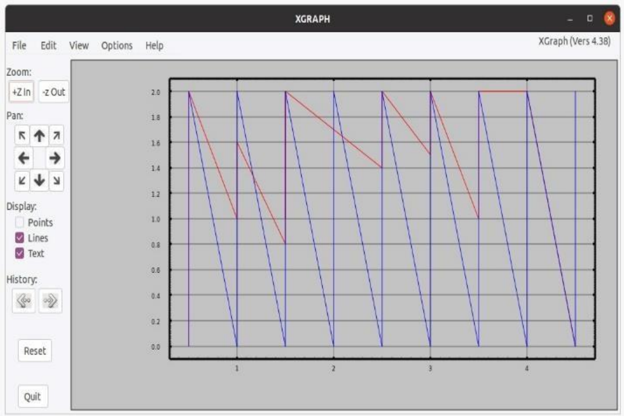

Figure 2: comparison between AODV and DSDV

The proposed ENAODV achieves a superior packet delivery ratio (PDR) by refusing to select the hub whose queue is currently full and increasing the support measure. PDR (Packet Delivery Ratio) varies with the number of vehicular nodes shifting between 20 and 100. progressively due to the ID-based model and RSUs' affiliation with the CA Central Authority, which gets rid of vehicle hubs that changed their path while exchanging data from the source to the destination, locating goals is made straightforward. As a result, many bundles are successfully delivered to the destination. comparison of packet delivery ratio between AODV and ENAODV. Where ENAODV show more packet delivery ratio as shown in Figure2.

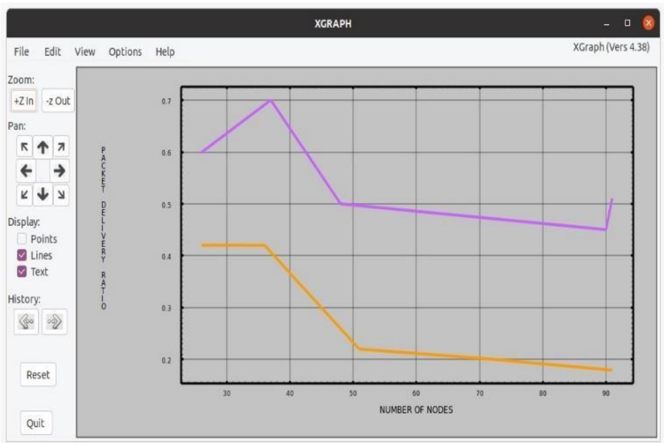

Figure 3: Purple: ENAOVD and Orange: AODV

The End-to-End delay on the NS-2.35 platform, the packet delivery has been calculated for an assumed network. It is noted that the suggested ENAODV achieves a reduced end-to-end latency, as illustrated in figure 3 for both protocols. The results show that node density varies between 20 and 100.

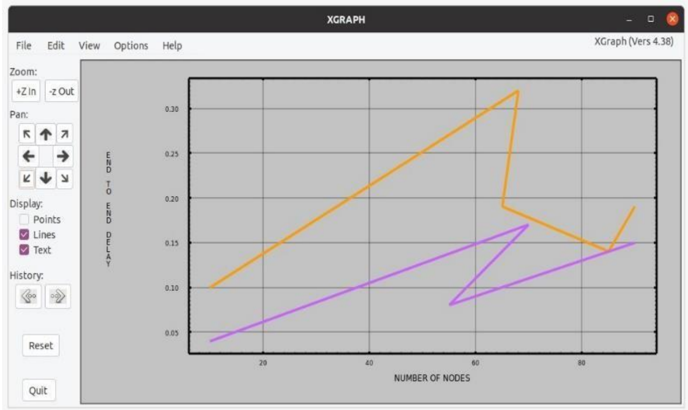

Figure 4 Purple: ENAODV and Orange: AODV

Throughput demonstrates how throughput changes when the number of vehicle nodes varies from 20 to 100, and the suggested ENAODV achieves a higher throughput as PDR grows. As the number of retrieved bundles increases, more information is retrieved.

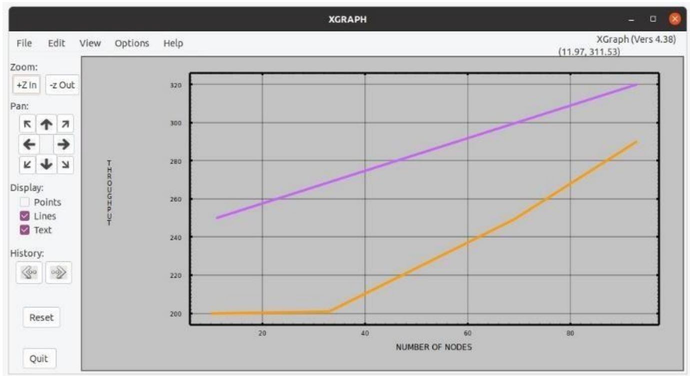

Figure 5: Purple: ENAODV and Orange: AODV

V. CONCLUSION

In conclusion, good results are seen when AODV and DSDV protocols in VANETs are compared. The transmitter that was intended for vehicle-to-vehicle communication performs well in both changing weather and real-world traffic situations. With potential benefits for improving traffic efficiency and safety, the results demonstrate how important protocol selection is for VANETs. This work establishes the foundation for the development of optimal communication systems that can significantly enhance overall road safety and traffic management in vehicular scenarios. The optimal protocol over DSDV is AODV.

And, this paper examines the issues and solutions related to Quality-of-Service (QoS) protocols in Vehicular Ad hoc Networks (VANETs). The study examines current QoS protocols and suggests the Enhanced Ad Hoc on Demand Distance Vector (ENAODV) routing system, highlighting the lively nature of VANETs. The methodology includes a comparison of the AODV and DSDV protocols, network architecture, SLAs, traffic classification, and QoS requirements. The results demonstrate the superior performance of ENAODV in terms of throughput, packet delivery ratio, and end-to-end delay under conditions of dynamic traffic. In conclusion, the study offers insightful information and presents ENAODV as a viable option for better communication in VANETs, enhancing traffic optimization and enhancing safety on the roads in intelligent transportation systems. The thorough analysis and experimental findings of the study improve our knowledge and use of VANET.

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