JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Bandwidth Efficient Approach for QoS improvement in VANET

Sadhana Parashar[1], Dr.Ravindra Tiwari [2]
[1,2] Department of Computer Science & Engineering, Lakshmi Narain College of Technology University (LNCTU), Bhopal, Madhya Pradesh, India.

Abstract : Vehicles are moving on the roads with different speed and continuously exchange the information of traffic for take right decision on roads. The vehicles are also extremely intelligent and can choose to go in a different direction if road construction or other factors cause traffic congestion at any location on the road. On rural and urban roads in the Vehicular Ad-hoc Network (VANET), traffic congestion management and handling are the most significant issues. Intelligent transport system is the public's demand for efficient traffic administration and management. The correct utilization of traffic status improves Quality of Service (QoS) and decreases unneeded delays in vehicle movement. In this paper, we propose an analysis of recent or existing schemes that have enhanced QoS during vehicles to vehicles or vehicles to RSU communication. The RSU is the accountable system, and its responsibility is to efficiently manage road load or traffic. In this research, performance of network measured by PDR, throughput and overhead metrices. Recent techniques are enhancing performance, but each approach has a few drawbacks that should be highlighted. Effective bandwidth utilization ensures that there is no congestion during routing, but achieving this is not simple. The comprehensive study is very useful for introducing innovation in the field of traffic management in VANETs.

***IndexTerms* - Congestion, QoS, Performance, Vehicles, RSUs, VANET.**

I. INTRODUCTION

Vehicular Ad hoc Network (VANET) is a exchanges messages between vehciles equipped with Road Side Units (RSUs) in vehicular regions [1]. The connection establishment for traffic information follows the standard MANET routing [2]. This enables information to be provided so that the driver can decide whether to take the usual route or an alternative route. It also assures the safety of the driver. Intelligent Transport Systems (ITS) are the most recent innovations in wireless communication technology for vehicle communication, and they have significantly reduced transport risks by focusing on accident prevention, collision damage reduction, emergency management, and driver safety. Communication between high-speed vehicular nodes is crucial. Historically, the VANET has contemplated two modes of communication. The first is inter-vehicle communication, and the second is connectivity between vehicles and roadside infrastructure. Multi-hop and hop-by-hop are two VANET communication techniques. Examples of VANET components that send packets in multi-hop mode include vehicles and roadside units (RSUs) [3]. Due to the constrained transmission range, communication is conducted through multiple hops between intermediate nodes. Vehicle equipped with On-Board Units (OBUs) that facilitate short-range wireless V-to-V or V-to-RSU communication as well as range-specific location information [4]. A RSU is the communication infrastructure device on the road. Different OBUs and RSUs communicate with one another to convey traffic data. Figure 1 depicts the operation of Vehicle to Vehicle (V-to-V) and V ehicle to RSU (V to RSU) communication in VANET. Here, only vehicles communicate with one another to share traffic data. Consequently, VANET is a dynamic network of automobiles devoid of fixed infrastructure such as a base station. Due to their velocity and acceleration, vehicles travel in a controlled manner.

It is the responsibility of the RSU to control the traffic on a specific area and then transmit the data to the server or other RSUs as necessary. When the number of vehicles connected to an RSU increases, channel contention at the RSU also increases, resulting in issues such as increased latency and possible packet loss, which degrades network performance overall. VANET deployment costs are substantially higher than MANET deployment costs. The MANET has low mobility compared to the VANET, whose vehicles are swifter. The characteristics of congestion mechanisms are determined by hop-by-hop and end-to-end, passive and active, Media Access Control (MAC), network and transport layers, and cross-layer methodologies [5]. When a network packet loss occurs, a congestion detection method detects congestion.

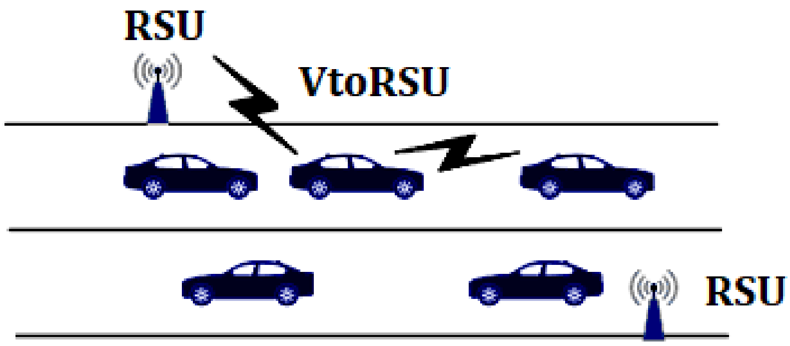

Figure 1.V to V and V to RSU

The characteristics of congestion mechanisms are determined by hop-by-hop and end-to-end, passive and active, Media Access Control (MAC), network and transport layers, and cross-layer methodologies [5]. When a network packet loss occurs, a congestion detection method detects congestion. The network then takes measures to alleviate the congestion. A congestion control system, on the other hand, employs multiple strategies to prevent congestion. Moreover, an effective and efficient mechanism for monitoring and controlling congestion enhances VANET Quality of Service (QoS), which is largely determined by packet loss and network overhead [6].

II. APPLICATIONS OF VANET

One of the most prominent methods for enhancing the effectiveness and security of contemporary transportation networks is the use of VANETS. For instance, to prevent traffic bottlenecks close to the impacted areas, vehicles can share early information about detours, accidents, and congestion with neighboring vehicles. Applications for VANETs allow cars to connect to the Internet and access real-time traffic, weather, and news information. Drivers and travellers can access a variety of information and create a huge number of applications in the VANET environment [7][8]. The OBU units of the cars use a variety of technologies, such as cutting-edge antenna technology, sensors, and efficient wireless access. In order to improve passenger comfort and ensure safety, the technology transfers data from the roadside unit to the other vehicles. It will talk with and gather information from other vehicles.

2.1 Applications for Efficiency

This application allows for increased movement of a vehicle by identifying it based on its present location within the city's lanes. In essence, communication between Vs and between Vs and RSUs occurs. Applications can be divided into two groups: reducing traffic jams and managing roads and crossings.

2.2 VANET applications for Safety:

The three fundamental VANET safety applications are driver assistance, alert information, and warning alerts. The vehicular safety communications consortium has identified eight potential safety-related applications: left turn assistance, lane change, emergency electronic brake light, traffic sign infringement, and pre-crash identification. We need to put in place significant road safety applications on our roadways in order to lower traffic accidents and fatalities. These programmes assist drivers in avoiding collisions with other vehicles on the road by providing them with timely, life-saving traffic information.

2.3 Comfort applications

In this context, there are businesses that offer drivers information they can use to enhance their trip experience. This kind of application may contain information about the weather, available parking spaces, maps of petrol stations and locations of restaurants.

2.4 VANET applications not linked to Safety

VANETs can also be utilised to deliver commercial or reassurance services. The effectiveness of advertisements, traffic efficiency, passenger comfort, and electronic toll collecting (ETC) are all improved by this type of application. These businesses provide applications that can locate parking lots, petrol stations, retail malls, motels, fast-food restaurants, and other points of interest (PoI) as well as weather information, traffic, hotels, and gas stations. It is believed that using the VANET for business applications and comfort will harm traffic efficiency and safety. It also detracts from and obstructs applications that are connected to safety..

III. QUALITY OF SERVICE IN VANET

Quality of Service (QoS) in Vehicular Ad Hoc Networks (VANETs) refers to the level of network efficacy and dependability offered to support various applications and services [5][6]. VANETs are a specific type of ad hoc network in which vehicles communicate with each other and infrastructure elements to exchange safety-related data, such as traffic conditions and road hazards. It is essential to ensure QoS in VANETs in order to support time-sensitive applications and enhance overall network efficiency [9][10]. Here are some important factors to consider when implementing QoS in VANETs:

VANETs should facilitate dependable communication between vehicles and infrastructure elements. For applications like collision avoidance, emergency messaging, and traffic management, reliable data transmission is crucial. Error control coding, retransmission mechanisms, and channel diversity are techniques that can improve reliability.

3.1 Communication latency

In VANETs, real-time applications require low communication latency. For safety-critical applications such as cooperative collision warning, it is essential to minimize the time between data transmission and reception. Prioritization, efficient routing protocols, and network architecture optimization can help reduce latency.

3.2 Bandwidth

VANETs necessitate adequate bandwidth to support a wide variety of applications and services. Streaming video, high-resolution maps, and the exchange of real-time sensor data necessitate substantial bandwidth. Bandwidth utilization can be optimized through effective resource management, channel allocation, and quality-aware routing protocols. The high speed networksa re able to improve bandwidth utilization [11].

3.3 Scalability

VANETs should be able to support scalable services and a large number of vehicles. The network should be able to adapt to variations in vehicle density and traffic conditions without degrading quality of service significantly. Scalability can be enhanced by hierarchical routing, aggregation, and dynamic resource allocation mechanisms. VANETs must assure the security and confidentiality of all transmitted data. Authentication, access control, encryption, and intrusion detection systems assist in preventing unauthorized access, tampering, and privacy violations.

3.4 Energy Efficiency

Due to the limited electrical resources of vehicles in VANETs, energy efficiency is crucial. While maintaining QoS, energy-aware protocols, power management strategies, and sleep/wake mechanisms can optimize energy consumption.

VANETs are susceptible to congestion, particularly in congested traffic scenarios. Congestion control mechanisms, such as traffic-aware routing algorithms, adaptive data rate control, and traffic prediction techniques, assist in reducing congestion and preserving QoS.

To attain the desirable QoS in VANETs, a combination of efficient network protocols, intelligent resource management, and stringent security measures is necessary. Future vehicular applications will rely on communication systems that are dependable, efficient, and secure.

IV. LITERATURE SURVEY

In this section, we examined prior research on the subject of VANET congestion control. The prior work provides knowledge of existing congestion-related work in order to efficiently utilise bandwidth and enhance vehicle communication QoS.

Wenfeng Li et al. [12] proposed an adaptive beacon generating rate (ABGR) for traffic control based on the number of vehicles on the road. This was done to resolve the previously mentioned channel congestion issues. The central concept of the ABGR mechanism is that the rate at which a vehicle emits beacons varies depending on the number of vehicles and the congestion threshold. When the density changes, the metrics for the QoS requirements of safety applications must change, not only for distinct safety applications but also for the same application.

- Evaluate bacon reception time with various node density; however, in the actual VANET scenario, the speed of vehicles is not always the same.
- An increase in beacon messages indicates inefficient bandwidth utilization.

Xiaofeng Liu [13] proposed a new algorithm for regulating traffic congestion that considers both the need for vehicles to be aware of their surroundings and the need to keep traffic congestion to a minimum.Each vehicle in this system utilises a variable gearbox power for each BSM. This implies that vehicles closer to a vehicle receive more BSMs from it, whereas vehicles further away receive fewer BSMs. In terms of safety, vehicles that are more similar to the EV have a greater impact on its safety. Consequently, it is essential that safety messages reach adjacent vehicles in a timely manner.

- The primary emphasis is on safety messages and transmission power, but safety messages packets required in the network and transmission power analysis are not mentioned.
- The percentage of traffic control and performance enhancement is not specified.

Marwan Aziz Mohammed et al. [14] describe a method for optimizing control channel (CCH) utilization and rendering control channel interval (CCHI) emergency-adaptive in vehicle settings. In emergency situations, a portion of the service channel interval (SCHI) is utilized to guarantee emergency message delivery. Finally, exhaustive simulations were conducted to validate the proposed optimized CCH utilization. The primary objective is to manage heavy traffic using Control Channel (CCH), but practical routes exist to circumvent traffic congestion.

- The number of incoming and outgoing vehicles at each terminal is absent from the report.

Sofiane Zemouri and her coworkers [15] developed a Prediction and Adaptation Algorithm (P&AA) to facilitate traffic flow in areas with stringent beaconing requirements. A quick TR and TP adaptation mechanism that assures a low collision rate and meets the level of awareness required to operate the majority of VANET applications. A novel short-term local density prediction method forecasts near-future channel demand, enabling the avoidance of utilization surges and the management of channel congestion.

- There is no need to evaluate power-related metrics because significant battery backup is already available.
- Packet loss due to congestion and collision analysis are absent from the results.

M.K Subramaniam et al. [16] proposed a TTDCA algorithm for controlling VANET congestion. The channel condition is used to identify vehicle environment congestion. Estimates are made of the channel's traffic, and congestion is identified. If traffic is detected using the vehicle congestion index (VCI), data can be transmitted to other automobiles and the RSU. Vehicles capture data on traffic, and VCD is used to locate traffic. (a dense population of vehicles). Path weight calculation (PWC) is a technique for calculating road grades in order to obtain up-to-date information for determining the optimal route for automobiles. The research has the following limitations: -

- Performance measures for various vehicle densities and speeds; and performance comparisons with no other existing approaches.

G. Soni et al. [17] presented a security strategy for VANET black hole attackers. Without security assurances, misbehaving or malicious vehicles in 6G-VANET make the system susceptible to providing subpar services or even placing user vehicles in perilous situations. The method detects the attacker's presence and estimates the total number of packets discarded by the black hole attacker in the network.

- Author focuses on assailant detection and prevention, but no comparison of 6G with other generation technologies is made.
- Infection analysis of attackers is not discussed.

Kashif Nisara et al. [18] proposed a method for determining the stability of a routing path using the k-hop method and the expected duration of a link. It is presumed that transceivers are designed within the cluster's head. The proposed solution employs packet-level quality routing to resolve the issue caused by placing packets with varying priorities in the same queue.

- There is no mention of information cluster members (CMs) in each cluster head.
- Discuss location information in the algorithm without mentioning the method or protocol for maintaining location records.

Sreya Ghosh et al. [19] proposed a technique for enhancing the efficacy of VANETs. In VANET, ACO is utilised to route data transmissions along the most efficient path. The key contribution of the proposed research is an ACO-optimization-based algorithm that is recommended to avoid situations in which data packets cannot be transmitted due to link failure caused by an unintended event, such as an accident.

- Pheromone value for multiple paths is not mentioned or evaluated in Ant colony optimisation.
- There is no mention of the location information fields captured by GPS. Also missing is the condition if the load is heavy on the shortest path and the lengthy path (not the longest path).

Ankita Srivastava et al. [20] proposed a strategy for achieving optimal outcomes. This work describes RDACO, which is a quality-of-service-based reliable route-finding algorithm for VANET that uses ant colony optimisation. Due to their prospective advantages, such as scalability, self-organization, robustness, adaptability, and failure resistance, bio-inspired techniques have recently attracted a great deal of attention. Research has the following disadvantages:

- Only one transmission is transmitted per second.
- The maximum speed of vehicles is 10 to 20 metres per second; network communications for 100 or 1000 packets are time-consuming. This velocity reduces the likelihood of congestion and link failure.

Boubakeur Achichi et al. [21] proposed a plan to reduce traffic congestion that combines event-based and measurement-based approaches. This combination makes it simpler to avoid traffic jams and expedites the transmission of security alerts regarding incidents. (a vital message such as the presence of an accident, precipitation, etc.). The disadvantages of research include: -

- Only postulated concept of congestion control; no evaluation of results.
- There is no mention of any approach's limitations.

V. Proposed Bandwidth Efficient QoS Approach

In VANET, Sending and receiving traffic data is essential in Vehicular Ad hoc Networks (VANETs) for ensuring efficient and safe transportation. VANETs enable vehicles to exchange real-time traffic data by communicating with each other and with roadside infrastructure. In addition, guaranteeing security and confidentiality during the transmission and processing of traffic data is a crucial aspect of VANET design. The step-by-step working is mentioned in figure 2.

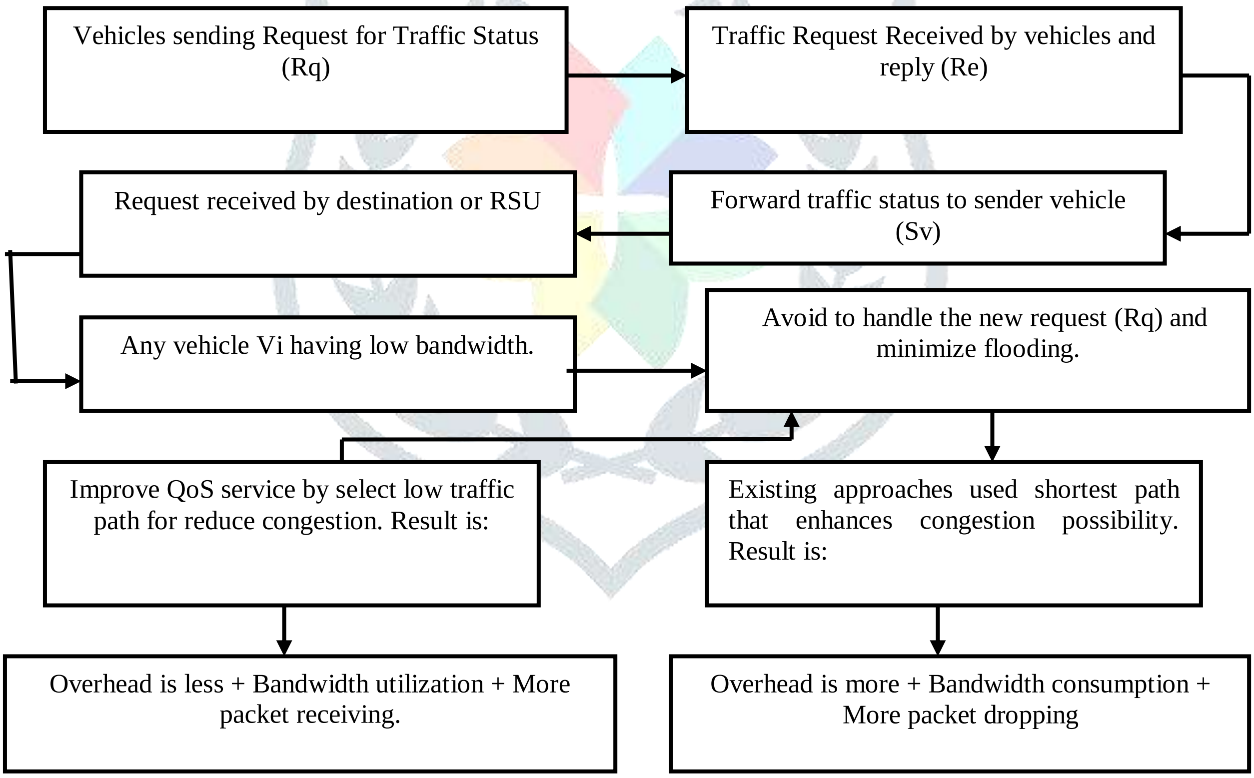

Figure 2. Steps to Improve QoS

.

VANETs require a robust and dependable communication infrastructure, which consists of a sufficient number of vehicles with communication devices, appropriately deployed RSUs, and effective communication protocols Various sources, including sensors in vehicles, infrastructure sensors, and external sources such as traffic management centres and weather services, can generate traffic data. This data may include information regarding traffic flow, congestion, road conditions, accidents, and other pertinent details. If vehicles are selected low traffic route than it will reach to destination on time. The low traffic route improves QoS and reduces possibility of traffic congestion in VANET. The processed traffic data, vehicles can display pertinent alerts or warnings to the driver via in-vehicle displays, audible signals, or haptic feedback. The motorist can then take appropriate measures, such as rerouting, slowing down, or modifying driving behavior, to mitigate potential dangers.

VI. RESULT AND DISCUSSION

In this In this section mentioned the performance of network with 50 vehicles and 4 RSU units. The high-density scenario showing the satisfactory performance.

6.1 Network Animator Scenario

The road map scenario is showing in figure 3. The vehicles are moving with different mobility speed and the destination is not common. The nodes are following the route where traffic is less or vehicles are continuously moving on the road. The shortest path is the first priority but due to traffic congestion avoid the heavy traffic routes.

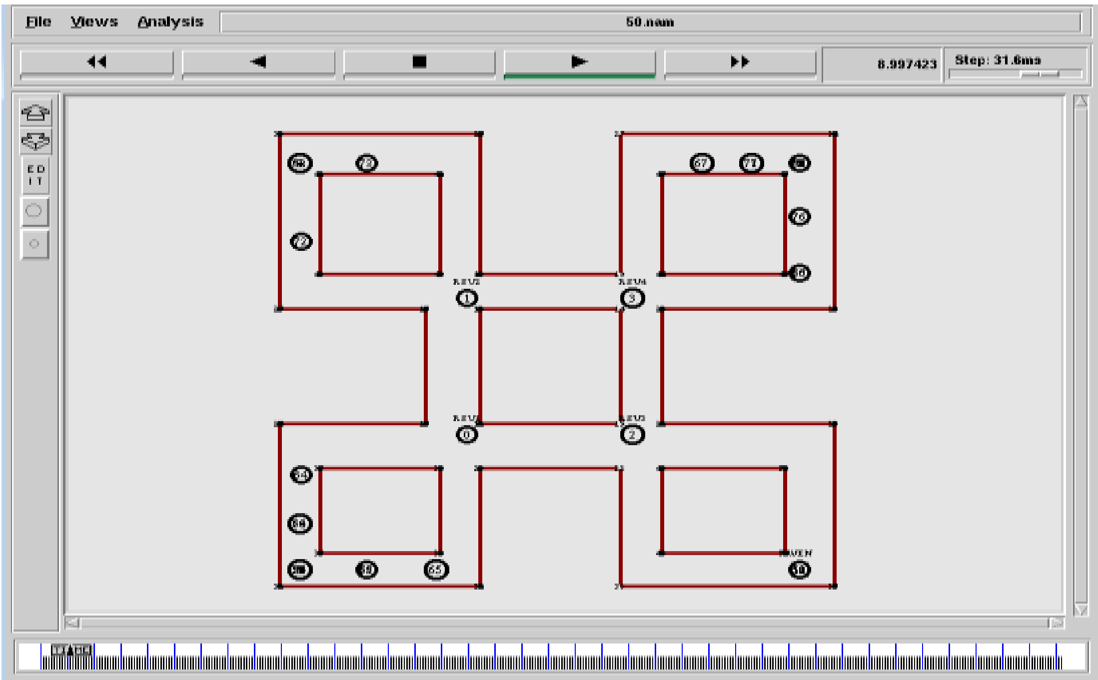

Figure 3 Road Map Scenario

6.2 Throughput Analysis

The number of vehicles is continuously sending the traffic information status request packets for confirm the traffic static if required. This graph is showing the throughput performance of 50 vehicles on road. high throughput means more and more number of vehicles accepting traffic information from leading vehicles in network that shows better QoS.

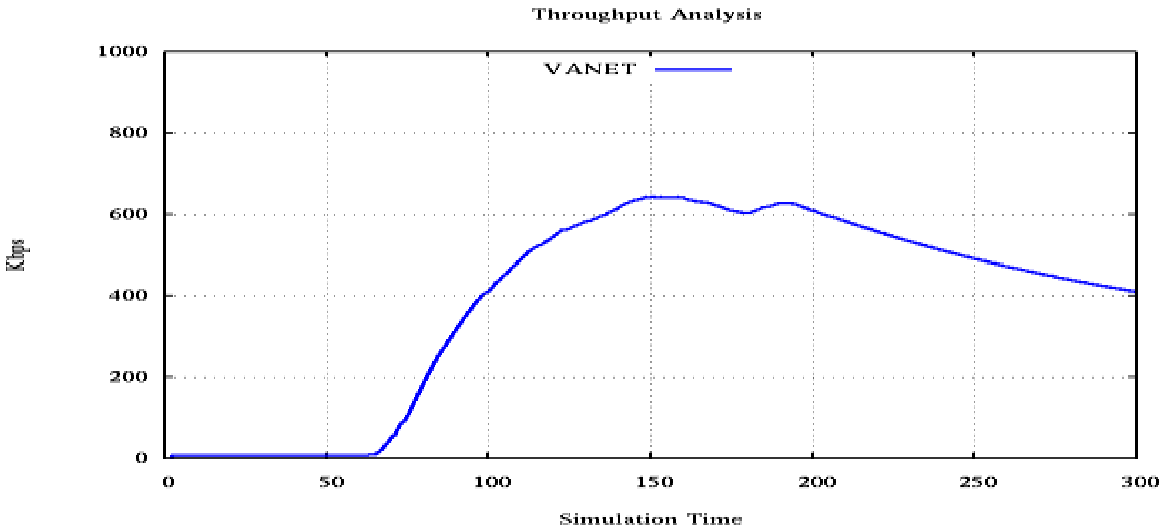

Figure 4. Throughput Analysis

6.3 PDR Analysis

The PDR performance is the ration of successful traffic information is received by vehicles in network. In the given graph PDR performance is not more than 65% because of heavy flooding of status request packets and status reply packet. In the given graph PDR is 60% maintained up to end of 300 seconds time.

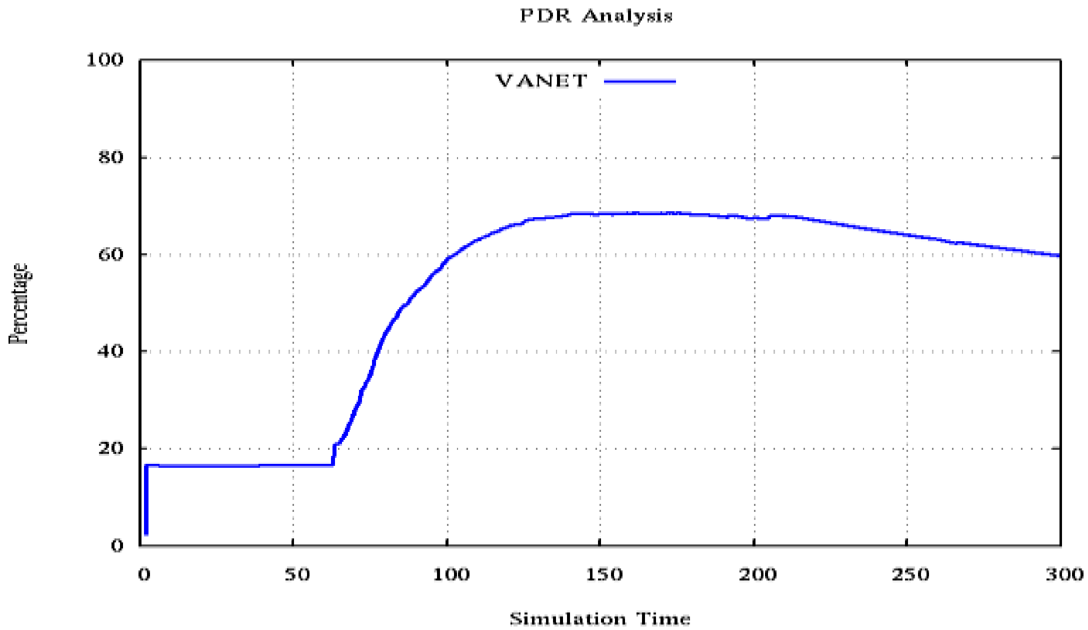

Figure 5. PDR Analysis

6.4 Overhead Analysis

The overhead packets are playing an important in proper communication of vehicles in network. The more status packets flooding consumes extra bandwidth and effect on processing capability. This graph is showing the overhead which is 3 minimum and at the beginning it is high. The low overhead is the sigh of better QoS.

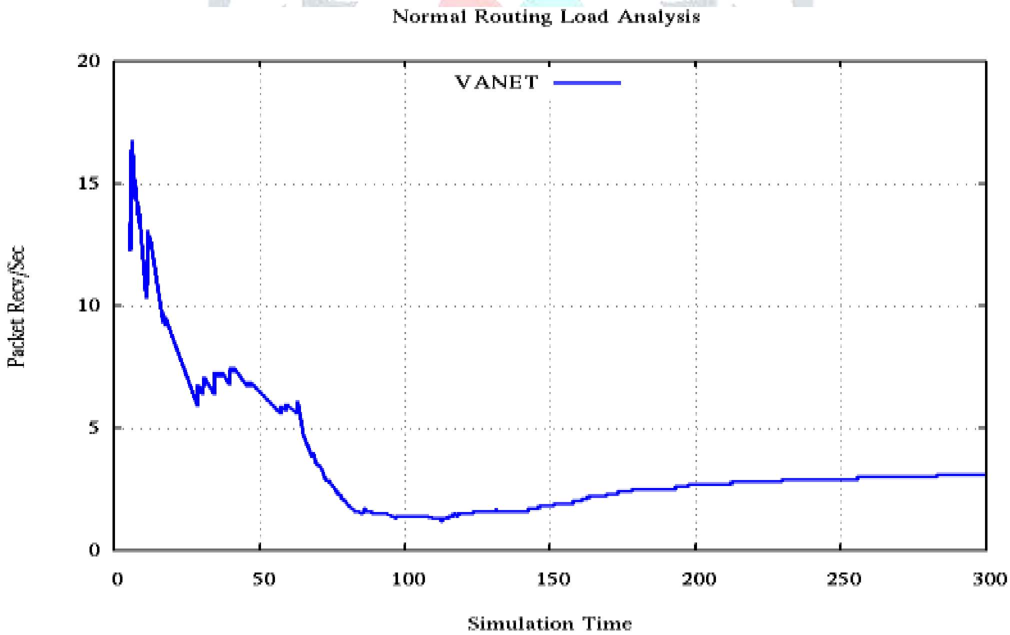

Figure 6. Overhead Analysis

VII. Conclusion and Future Work

Vehicles are able to interact with each other and relay information either directly to the RSU or to nearby vehicles. The V to V and V to RSU scenarios are distinct, and a RSU's congestion-handling capability exceeds that of a single vehicle in the network. In this research, we present a analysis of different schemes that concentrate on quality of service (QoS) improvement in VANET. The advantage of a research is that you can read the latest research work of different authors, point out the drawbacks, and propose a new approach for congestion control and performance improvement using congestion and load balancing rules for improving QoS. The UAVs are capable of giving direct instructions to any vehicle during normal communication. The normal vehicles are not able to evaluate the data to determine whether or not it is correct or incorrect. In this analysis, mention the applications, routing protocols, and QoS issues in VANET. The bandwidth and processing capabilities of vehicles are always challenging for researchers to handle and transfer properly over VANET. The vehicles aim is only to follow the routes, but the decision to travel on a route is based on the traffic-related information flooding from leading nodes in the network. In normal cases, any vehicle can establish a connection and exchange traffic information over VANET. The congestion-control techniques discussed in this paper are reliable but have some drawbacks. The aim of each approach is to improve accuracy and give better results than previous techniques.

In the future, propose a novel approach for control the congestion and improve the quality of service in the network. The congestion control scheme improves routing performance and reduce the flooding for efficient bandwidth utilization in VANET.

REFERENCES

[1] Mutuma A. G. Hameed and M. S. Mahmoud, "Vehicular Ad-hoc Network (VANET) – A Review," Iraqi International Conference on Communication and Information Technologies (IICCIT), pp. 367-372, 2022

[2] Kamlesh Chandravanshi, Gaurav Soni, Durgesh Kumar Mishra, "Design and Analysis of an Energy-Efficient Load Balancing and Bandwidth Aware Adaptive Multipath N-Channel Routing Approach in MANET," IEEE Access, Vol. 10, pp. 110003 – 110025, 2022.

[3] Arun Singh Kaurav, Sushama Rani Dutta, "Detection and prevention from different attacks in VANET: A Survey," International Conference on Physics and Energy 2021 (ICPAE 2021), Volume 2040, 2021.

[4] G. Soni, M. K. Jhariya, K. Chandravanshi and D. Tomar, "A Multipath Location based Hybrid DMR Protocol in MANET," 2020 3rd International Conference on Emerging Technologies in Computer Engineering: Machine Learning and Internet of Things (ICETCE), pp. 191-196, 2020.

[5] M. Sepulcre, J. Gozalvez, O. Altintas, H. Kremo, "Integration of Congestion and Awareness Control in Vehicular Networks," Ad Hoc Networks, Vol. 37, pp. 29-43, 2016.

[6] M. Ishaq, M.H. Malik, M. E. Aydin, "Managing Congestion in Vehicular Networks Using Tabu Search," Engineering Applications of Neural Networks (EANN), Communications in Computer and Information Science, Vol 893, 2018.

[7] Michael Lee, Travis Atkison, "VANET Applications: Past, Present, and Future," Vehicular Communications, Vol. 28, 2021.

[8] Radha Krishna Karne, Dr. T.K.Sreeja, "Review on VANET Architecture And Applications," Turkish Journal of Computer and Mathematics Education, Vol12(4), 2021.

[9] G. Soni, K. Chandravanshi, "A Novel Privacy-Preserving and Denser Traffic Management System in 6G-VANET Routing Against Black Hole Attack," Sustainable Communication Networks and Application, Lecture Notes on Data Engineering and Communications Technologies, vol 93, pp. 649-663, 2022.

[10] Suman Malik, Prasant Kumar Sah, "A comparative study on routing protocols for VANETs,"Heliyon, Vol.5(8), 2019.

[11] G. Soni, K. Chandravanshi, A.S Kaurav, S.R. Dutta, "A Bandwidth-Efficient and Quick Response Traffic Congestion Control QoS Approach for VANET in 6G," Innovations in Computer Science and Engineering. Lecture Notes in Networks and Systems, Vol 385, 2022.

[12] Wenfeng Li, Wuli Song, Qiang Lu, Chao Yue, "Reliable congestion control mechanism for safety applications in urban VANETs," Ad-Hoc Network, pp.1-12, 2020.

[13] Xiaofeng Liu, Ben St. Amour and Arunita Jaekel, "Balancing Awareness and Congestion in Vehicular Networks Using Variable Transmission Power," electronics, pp.2-16, 2021.

[14] Marwan Aziz Mohammed, Shareef M. Shareef, and Kayhan Zrar Ghafoor, "Adaptive and Optimized Control Channel Utilization in Vehicular Ad Hoc Networks Marwan Aziz," Wireless Communications and Mobile Computing, Willey, 2022.

[15] Sofiane Zemouri, Soufiene Djahel, John Murphy, "An Altruistic Prediction-Based Congestion Control for Strict Beaconing Requirements in Urban VANETs," IEEE Transactions on Systems, Man, And Cybernetics: Systems 1, pp.1-16, 2019.

[16] Mahendrakumar Subramaniam, Chunchu Rambabu, Gokul Chandrasekaran, Neelam Sanjeev Kumar, "A Traffic Density-Based Congestion Control Method for VANETs," Wireless Communications and Mobile Computing, pp.1-12, 2022.

[17] Gaurav Soni, Kamlesh Chandravanshi, "A Novel Privacy-Preserving and Denser Traffic Management System in 6G-VANET Routing Against Blackhole Attack," Sustainable Communication Networks and Application, 2022.

[18] Kashif Nisara,d, Abubakar Aminu Mu'azub Ibrahim A. Lawalc, Sohrab Khand, Shuaib Memon, "Reliable Priority Based QoS Real-Time Traffic Routing in VANET: Open Issues & Parameter," IEEE 14th International Conference on Application of Information and Communication Technologies (AICT), 2020.

[19] Sreya Ghosh Saha Misra, "Enhanced QoS Performance with Reduced Route Overhead by Ant Colony Optimization Algorithm for VANET," IEEE Proceedings of IEEE Applied Signal Processing Conference (ASPCON), pp. 237-241, 2020.

[20] Ankita Srivastava, Arun Prakash Rajeev Tripathi, "Quality-of-Service based Reliable Route Discovery using Ant Colony Optimization for VANET," IEEE Conference on Information and Communication Technology (CICT), 2019.

[21] Boubakeur Achichi, Fouzi Semchedine, Lakhdar Derdouri, "Hybrid Approach for Congestion Control in VANETs," IEEE Proceedings of the 7th International Conference on Software Engineering and New Technologies (ICSENT-2018), pp.1-4, 2018.