ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)

Volume 11 Issue 4 April 2024

# An Optimized Link State Routing Technique for Vovan's Using G.711 Codec

[1] M.K. Kishore, [2] P. Veerendra kumar, [3] B. Poojitha Keerthi, [4] CH. Chandini, [5] A. Naga Rajesh

[1] Assistant Professor, Department of Electronics and Communication Engineering, Usha Rama College of Engineering and Technology, Telaprolu. Ungutur Mandal, Krishna district, Andhra Pradesh -521109

[2], [3], [4], [5] IV B. Tech Students. Department of Electronics and Communication Engineering, Usha Rama College of Engineering and Technology, Telaprolu. Ungutur Mandal, Krishna district, Andhra Pradesh -521109

Corresponding Author Email: [1] Kishore5511@gmail.com, [2] pveerendrakumar8@gmail.com, [3] poojithakeerthibavurapalli@gmail.com, [4] chanduchandu8500@gmail.com, [5] allaparthinagarajesh@gmail.com

***Abstract***— ***VoIP provides high-quality services via the use of Vehicular Ad-hoc Networks (VANET). These networks encounter many challenges in order to provide voice interactions with satisfactory quality of service (QoS). The performance of VoIP applications on the VANET network is analysed using the OLSR Routing Protocol. Subsequent to the execution of the OLSR algorithm, the network underwent testing. The testing focused on evaluating Quality of Service (QoS) characteristics, such as end-to-end latency, delay variation (jitter), and chance of packet loss. This was done using the ITU G.711 VoIP codec, and the tests were conducted between multiple nodes in multi-hop ad-hoc networks under different scenarios. After measuring the QoS parameters for packet loss, jitter, and delay for different scenarios, the approach got average packet loss about 0.37%, average jitter 10.65%, and average delay is 90.21%. The OLSR performed well during the first four hops. By including more hops, the delay significantly rising, above the threshold of 400ms, therefore violating the established criteria set by ITU-T. Rather of employing a simulation, this was accomplished by constructing a testbed to extract the needed findings.***

***Keywords: Voice over Internet Protocol (VoIP), Vehicular Ad-hoc Networks (VANET), Quality of Service, OLSR***

## I. INTRODUCTION

Wireless mesh networks allow numerous devices to share internet access and for units to speak directly without first going via the internet. Intelligent transportation systems (ITSs) recognize the general expansion of smart city approaches and provide fresh, low cost solutions for clients. As an essential aspect of ITSs and smart cities, vehicle ad hoc networks (VANET) are drawing the broad courtesies of more and more organizations and enterprises. Mobile ad-hoc networks (MANET) are ambiguous networks including mobile stations (MSs) equipped with wireless cellular and network abilities, cooperating without any network's core structure. The existence of this network opens the ground for a broad variety of application scenarios, such corporate and home networks, emergency applications, wireless sensor etc.VANET is an explicit category of MANET, delivering Realtime data and applications that can be vital for keeping people in a city or highway connected in a lively atmosphere improved with security and simple driving. But such a network poses various limits, such fast mobile vehicles, quick and constantly changing network topologies, susceptibility to delay and jitter, etc. These qualities differentiate it from another mobile ad-hoc network. VANETs are a sort of network that is fashioned by the notion of constructing networks of vehicles for an explicit demand or condition has increasingly been acknowledged as a robust network that automobiles exploit for communications reasons on the roadway or in crowded metropolitan areas. There are a number of challenges with VANET, such as the guarantee of QoS, steady communication, spectrum and integrity, and security for automobiles and passengers' privacies. Voice-over-internet protocol (VoIP) is one of finest and most significant technology that permits the production of voice calls using Internet connections. As it is the commonly understood, quality-of-services (QoSs) are critical one for VoIP services over VANETs, which notably necessitate a restricted end-to-end jitter and a low packet-loss ratio. G.711 has the capacity to transfer data at a rate of up to 64 kbps. The literature analysis verified that the Optimized link state routing is the most effective for VoVan in terms of latency and jitter. nonetheless it has to grow to become more dynamic and flexible, especially when it comes to resource restrictions on nodes, hostile control of wireless channels, fast changing topologies, and the absence of crucial administrations. The constraints provided by these boundaries create substantial barriers to the maintenance of VoIP quality-of-services (QoSs) with regard to packet delivery ratio (PDRs) and end-to-end delays, delay variation. This study goals is to analyze voice traffic to control the route in demand to acquire a better performances and resources utilization of the networks and for guarantee of persuaded good QoS for the transmitted data. To deliver real-time VoVan, a testbed has been developed for different scenarios. According to Quality of Service (QoS) criteria, a range of metrics may be applied to define the qualities of media streams and signals. The various QoSs metrics, including battery life, energy consumption, packet drop probability, bandwidth, end-to-end delays, jitters, and throughput cost.

Substantial research are undertaken in both academia and automobile industry for boosting the QoS performances by examining all of these components and aspects.

## II. LITERATURE REVIEW

VANET using an enhanced Harmony Search Optimization method [2], outlining the settings and setup for the simulation, displaying metrics, evaluating the findings, and wrapping up the task. Predetermined parameters pertaining to message timeouts, validity time, MPR willingness, and HOLD TIME govern the OLSR protocol. For vehicle ad hoc networks, a fuzzy-clustering-based routing algorithm [3] enhances quality of service efficiency and performs current techniques. The suggested approach emphasizes efficient use of resources by variables like distance, energy left, and number of neighbors. concentrate on particulars, neglect to address implementation issues, the need for further research on mobile vehicle privacy, and failure to take into account possible problems or negatives. creating a simulation model [4] and comparing the performance of the AODV and OLSR routing protocols against stationary and mobile wormhole assaults using metrics such as packet delivery ratio, throughput, and normalized routing overhead. The simulation model is created using the NS-3 simulation tool. [5] choosing the ideal surrounding neighborhood to live in, choosing appropriate neighboring cars, figuring out how long a connection will last, and utilizing C programming to simulate different network situations. Important tasks include creating the topology, implementing velocity, running the algorithm, and calculating system performance. The study used the regional condition-aware hybrid routing protocol (RCA-HRP) [6], which simulates traffic using NS-3. The results are compared with current protocols, mesh node weight values are determined, and the best pathways for various traffic patterns are chosen. Fog computing [7] is a trust assessment technique that models time-varying misbehaviors, presents a multi-path selection criteria, and suggests a cross-layer traffic allocation mechanism. It also measures the impact of misbehaving cars on service delivery. The knowledge about misbehavior dynamics for service delivery in adversarial contexts is not taken into account by the hybrid trust models that are mentioned. the need to look at increasingly complex attacker models and assess the overall strategy in various network circumstances. [8] using a cross-layer routing technique based on IEEE 802.11p to evaluate several transmission models in terms of RSS and measure their performance in PDR, throughput, and latency. The research finds issues with the PHY when there are a lot of vehicles and suggested method. The AODV routing protocol may be improved by using the QoS-nearest neighbor (QoS-NN) approach [9], analyzing it with different network settings, comparing its performance with the lexicographic order method, and modifying the K-NN algorithm. channel assignment in multi-interface multiple channels of communication nodes [10], emphasizing the efficacy of the multi-channel assignment OLSR protocol in enhancing network performance and the superiority of the multi-interface multiple channels of communication OLSR protocol over the single-interface single-channel OLSR protocol. The performance comparison shows that the multi-interface multi-channel OLSR protocol performs better than the single-interface single-channel OLSR protocol in terms of network throughput, end-to-end delay, packet loss rate, and jitter. The primary function of the OLSR protocol is to maintain the routing table. Additionally, it is shown that the multi-channel allocation OLSR protocol performs better than the multi-interface multi-channel OLSR protocol. NS-2 is used for network simulation in VANETs, while SUMO [11] is used to generate mobility traces and traffic models. After generating a mobility trace file using MOVE, NS-2 was used to construct a simulation file for VANET. For the simulation region, SUMO was used to provide realistic mobility traces of vehicle traffic.

## III. METHODOLOGY

A lot of study has been done on VANET networks in the literature, particularly on how well they function in different scenarios, such as at the physical, MAC, IP, or application layers. However, it is expensive and challenging to achieve in simulation the assessment of real-time VOVANs. Thus, in this study, we attempted to implement a discrete-driven simulation for voice-over IP over VANET in real-time. OLSR Switch Agent, Linux OS, Ns2 were utilized to create traffic for this particular goal. The topology of this network is wireless mesh networks where every node is decentralized in nature.

```
Algorithm 1
Each MPR route for OLSR VANET,
Broadcast (TC message),
Forward TC messages to only MPR,
Type < = TC message,
TTL = 225,
Top_Hold = v-time,
Sequence number = extract from the packet,
Neighbor _Address = extract from the packet,
If TC message size > the Neighbor _Address,
begin_If
{
Generate more TC messages,
Continue until whole the neighbor in the network is covered
} end_if,
Else declare Only one TC message,
End,
```

The proactive routing method known as OLSR is thought to function well for mobile nodes connected to ad hoc networks. The suggested method, which makes use of the OLSR protocol, obtains the stability of the topology-control (TC) messages or link-state procedure/messages that are delivered. Because of its proactive qualities, it also has the advantage of creating routing tables that are instantly available when needed. Specifically designed for mobile nodes in ad hoc networks, the suggested method-based OLSR is an provement over the traditional link-state procedure/topology control (TC) messages. Fig. 1 displays the suggested TC messages in OLSR.

The standard link-state process that was created to specifically address the needs of mobile nodes in wireless local area networks (LANs) is streamlined into the topology control (TC) messages that are recommended for OLSR. The basic principle employed in the suggested approach is that of multipoint relay (MPR). MPR aims to reduce identical retransmission while sending a large number of packets at once.This technique restricts the amount of packets that a subset of all network users can retransmit from another subset of mobile devices. The subset size relays on the network topology [12]. MPR is the method by which nodes choose which broadcast packets to forward during overflowing operations.

This method, which significantly reduces packet overhead, is similar to a traditional flooding technique in which each mobile station resends every packet after receiving the first version of the packet. Only a mobile station known as MPR produces the link-state data channel in the OLSR-based topology control. The pseudo code is presented below in Algorithm

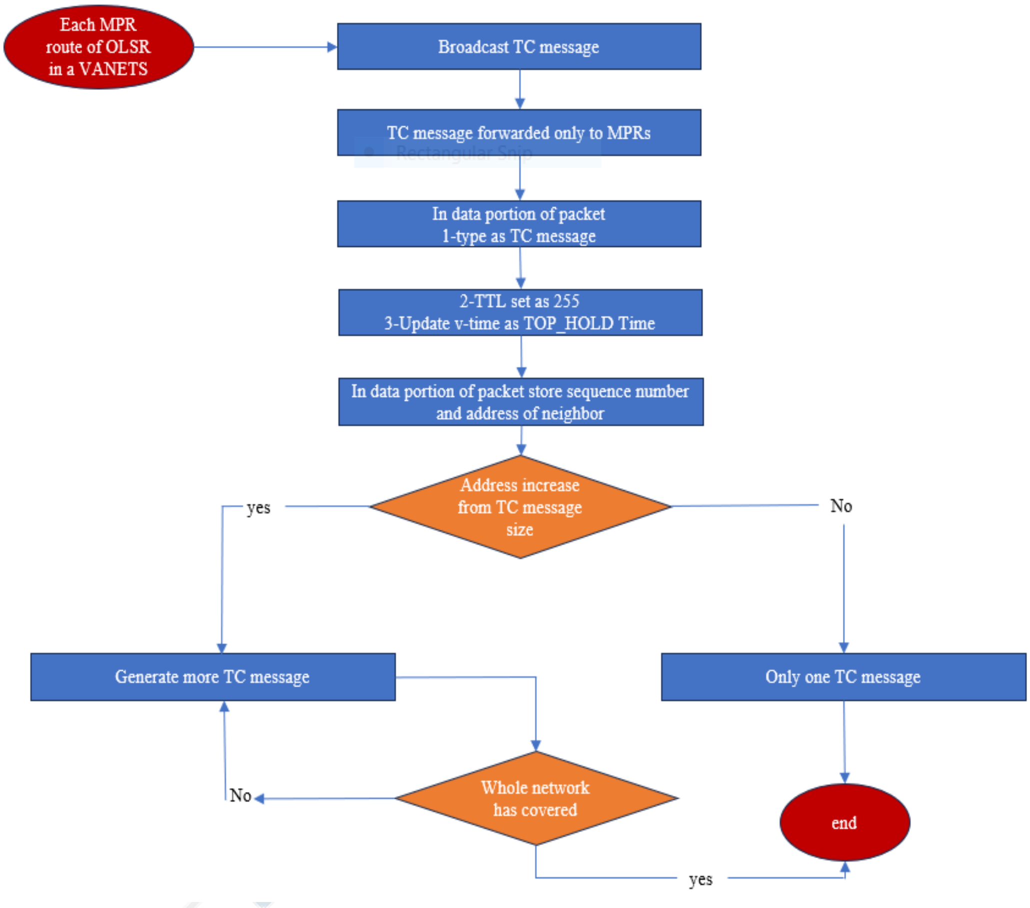


**Fig. 1** Flow chart of proposed topology control (TC) messages in OLSR.

Therefore, reducing the quantity of control packets that flood the networks allows for the achievement of a second optimization. In the third stage of optimization, MPR nodes have the option to simply transmit the link information between the MPR elector and themselves. As a result, fractionated link-state data is distributed throughout the networks, which is different from the conventional link-state model. The MPRs then use this information to calculate routes. A route that is less ideal in terms of number of hops is provided by an OLSR-based control message. Since the MPR approach works well in this framework, the suggested method is mostly suitable for the large and compact network.

Phase 1

By listening for HELLO packets, each mobile station may determine which neighborhoods it is in and what sort of neighbors it has (asymmetric and symmetric). From this point forward, we shall only take into account neighbors of the type Symmetric for the purpose of simplicity.

Phase 2

As small a subset of Ni + 2 as feasible must be chosen by each mobile station. Another bit, NOT_MPR/MPR, makes up each neighbor's in form of HELLO packets.

ISSN (Online) 2456 -1304
International Journal of Science, Engineering and Management (IJSEM)
Volume 11 Issue 4 April 2024

Each MPR therefore identifies the group of its electors. The only station that floods packets with messages from its electorate is the MPR network.

Phase 3

Each MPR station will generate Topology control packet. TC packet consists the elector group of the MPR that produced it. The MPR's elector group is included in every TC packet.

OLSR Agent is an implementation of OLSR using RFC3626 [7] is known as OLSR-based TC messaging. This technique optimizes mobile nodes in ad hoc networks on embedded nodes, such as shelf router, smartphone, or desktop computer advertisements. Occasionally this sort of network is termed a mesh network.

- OLSR Agent major advantages:
- An open-source project is OLSR Agent.
- Topologies that are unique can be made.
- OLSR executes genuine programs.

ITU-T specifications for voice compounding are found in the G711 family. This is mainly employed in telephone circuits. The old title of this article was Voice Spectrum PCMs. G711 also may be employed in fax transmissions over IP connections [8].

The G711 narrow-band voice codec provides high-quality 64 Kbps audio [13]. Voice signaling in the 0.3–3.4 KHz range is allowed by G711, and 8 K samples per second can be sampled in this range.

G711 lists two important compression techniques, including the m law method used in Japan, Canada, and the United States. A legal strategy used throughout the European Union and the wider world. Both are logarithmic-based methodologies; however, A law was carefully constructed to be straightforward for the computation process and gave high quantization levels at low signal magnitudes.

## IV. SIMULATION SETUP

### 4.1 Initial Scenario: Measuring performance with a single hop

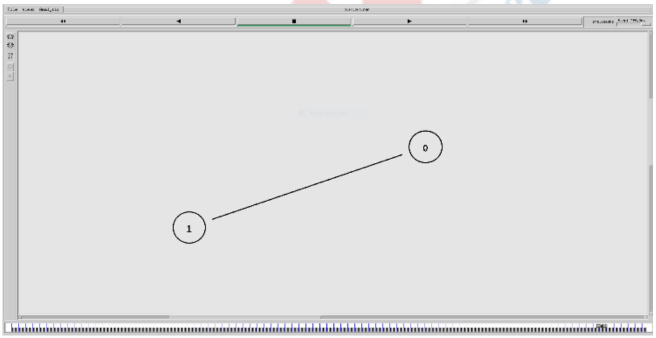

**Fig. 2.** clearly displays the setup was made from the station (10.0.0.1) and node 2 (10.0.0.2).

The first simulation in Fig. 2, had a delay of 20.40 ms, jitter of 122. ms, and packet loss of 0.2% using the OLSR algorithm.

### 4.2 The second scenario : Measuring with two hops.

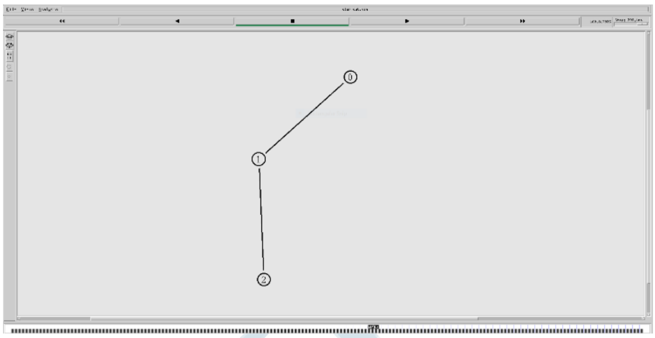

**Fig. 3.** illustrates the setup was made from station (10.0.0.1) and node2 (10.0.0.2) to node3 (10.0.0.3).

The second case had a delay of 43.82 ms, jitter of 7.24 ms, and packet loss of 0.25% using the OLSR algorithm

### 4.3 Third Scenario: Utilizing three hops.

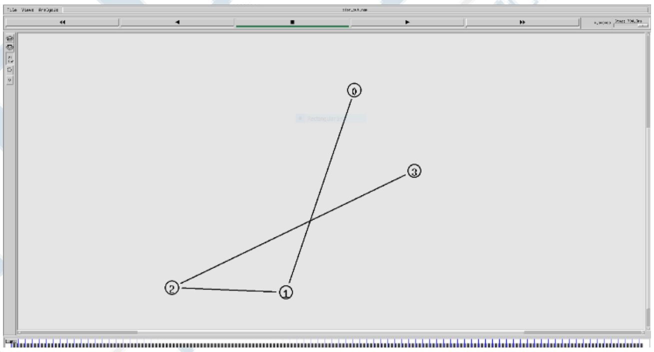

**Fig. 4.** illustrates the call that was made from station (10.0.0.1) and node2 (10.0.0.2) to node3 (10.0.0.3) and node4 (10.0.0.4).

The third using the OLSR algorithm, the packet loss was 0.38%, the jitter was 14.67 ms, and the delay was 112.75 ms.

Due to the coding and encoding procedure for each packet that arrived at the hops, there was a significant packet loss in the second and third scenarios (i.e., three hops) and a twofold increase in delay and jitter. In this situation, the packet's TTL (time to live) needs to be increased to account for the processing delays linked to each hop's packet forwarding and reception.

### 4.4 Fourth Scenario:Measuring performance using four hops.

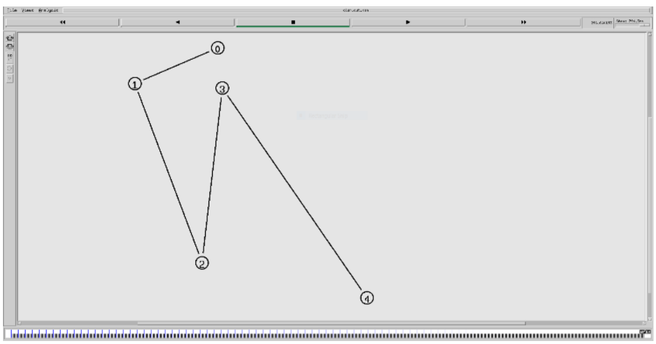

Fig. 5, setup was made from station (10.0.0.1) and node2

ISSN (Online) 2456 -1304

International Journal of Science, Engineering and Management (IJSEM)

Volume 11 Issue 4 April 2024

(10.0.0.2) through nodes 3 (10.0.0.3), 4 (10.0.0.4), and 5 (10.0.0.5). using the OLSR algorithm, the packet loss was 0.65%, the jitter was 19.50 ms, and the delay was 183.88 ms.

## V. RESULTS AND DISCUSSIONS

. There are two key structural differences between VoIP data flows and other types of data flows. The payload's size is the first variance. Network messages are commonly composed of two parts: payloads and headers. The actual data that needs to be transmitted and delivered is contained in the payloads, whereas the packet headers contain information and control concerns related to data transmission. Since the length of the header in any network is typically fixed for every message, using a big payload length to increase network speed is standard. However, because the data that needs to be conveyed heavily relies on the rhythm of human speech, voice communication typically has a payload length that is even shorter than the header.

**Table 1** Test Results of all Scenarios.

| Scenario No | QoS of VOVAN | | |
|---|---|---|---|
| | Delay (ms) | Jitter (ms) | Packet Loss % |
| 1 | 20.40 | 1.22 | 0.22 |
| 2 | 43.82 | 7.24 | 0.25 |
| 3 | 112.75 | 14.67 | 0.38 |
| 4 | 183.88 | 19.50 | 0.65 |

In the above table 1 illustrates the quality of service parameters over vehicular Ad-hoc networks with delay, Jitter, Packet loss ratio from four scenarios. The network uses the channel less frequently as a result of this circumstance. The second variant stems from the fact that human listening can generally maintain a reliable quantity of packet loss rate (less than 5 percent). The suggested OLSR, which is based on MPR, significantly decreased the packet overhead in the four instances listed above. The MPR for each of the four situations consisted of chosen nodes with the ability to broadcast messages in real time via the network's voice message flow utilizing OLSR. As a result, both before and after the suggested OLSR is implemented in the simulated scenario, packet overhead significantly decreases. Only a node identified as MPR is able to provide the link-state voice channel in the proposed OLSR-based topology control. The below Table 2 defines the QoS parameters with 4 scenarios

**Table 2.** Average results of all scenarios

| OLSR Algorithm | QoS of VOVAN | | |
|---|---|---|---|
| | Delay (ms) | Jitter (ms) | Packet loss % |
| | 90.21 | 10.65 | 0.37 |

### A. Analysis of Results Delay

Transporting a high voice quality-of-service (QoS) comparable to that provided by networks is the ultimate objective of VoIP traffic. The transfer of VoIP data over wireless networks presents a number of problems. For instance, the transfer of VoIPs might occasionally result in unforeseen delays and packet loss probability due to the nature of the wireless medium-access channels.

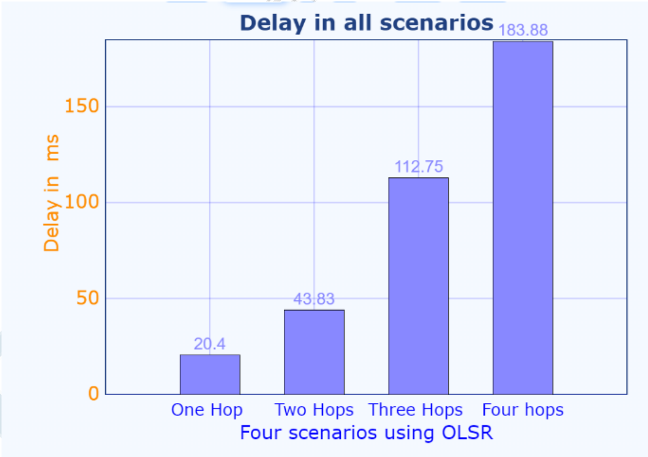


**Fig. 6.** Delay in all Scenarios

### B. Jitter Analysis of Results

Since each VoIP connection has a different path and number of hops, real-world data for every VoIP conversation in the mobile ad hoc network must be gathered. Because there are variations in the number of hops in each situation, the VoIP call jitter varies as well.

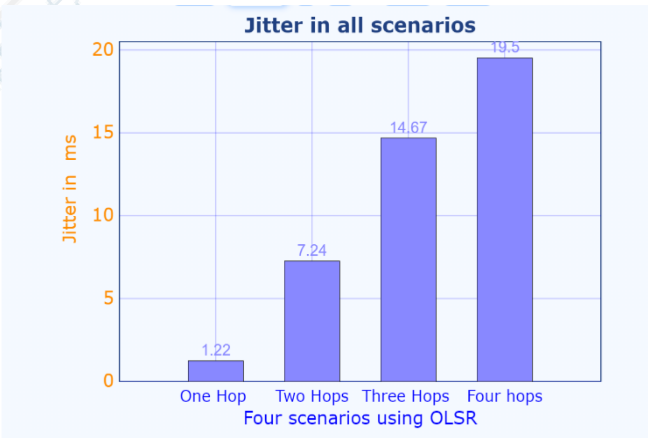


**Fig. 7.** Jitter in all Scenarios

### C. Ratio of Packet Loss

VoIP services react very subtly to lost packets. Despite the fact that VoIP messages and packet loss ratios up to 12% are accepted. ITU-T states that the 1.2% packet loss ratio still has an impact on the VoIP service stream's quality.Following the installation of OLSR Switch, the network performed significantly better in the opening scene. Using OLSR, the average network delay was 90.21 ms.

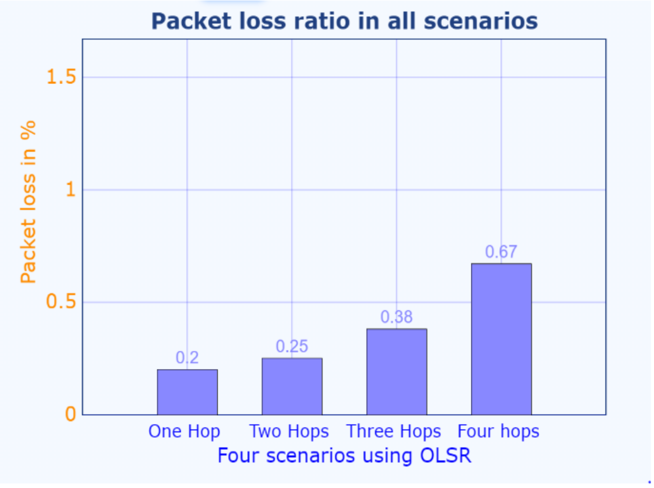


**Fig. 8.** Packets loss ratio in all scenarios.

Based on the outcome, a MATLAB algorithm has been developed to determine the second-order derivation of the delay and jitter, hence offering a reliable projection for multi-hop delay and jitter. Since delay quality of service (QoS) in real-time communication systems is crucial, the ITU established the maximum delay for voice applications in communication systems in real-time, which is 400 ms. As was previously said, several hops can effect delay QoS.

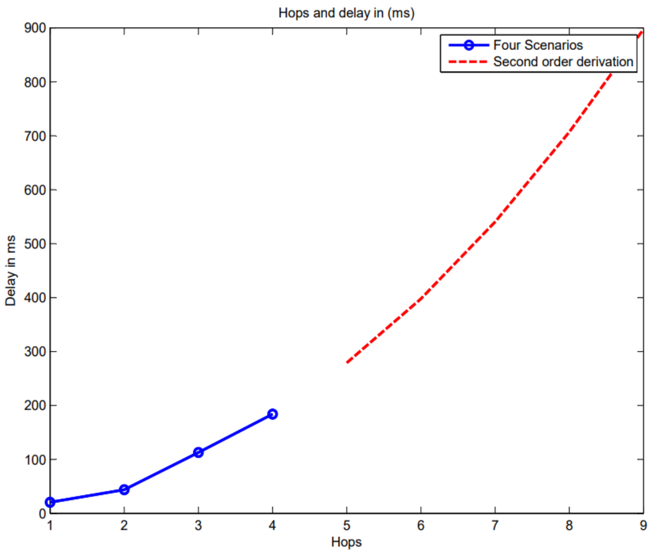


**Fig. 9.** The second-order derivation for the delay

Enhancements to the OLSR agent can lead to a significant improvement in the performance of OLSR-based TC messages, which are designed for optimal OLSR. When the number of hops in Fig. 9 reaches 6, the delay surpasses 400 milliseconds. As a result, there are five hops that six terminals can implement. Figure shows that the latency increases exponentially as the number of hops increases. This is because real-time traffic causes the delay, which would be significantly improved in audio streaming.

## VI. CONCLUSIONS

In the world of networks, VANETs are among the most advanced. These days, real-time voice applications over VANET networks are highly desired and necessary, especially in emergency or safety situations involving VANETs. This research used the optimized link-state routing (OLSR) process to offer an examined scenario for VoIP applications over VANETs performance evaluation inside the framework of G711 codecs. This work proposed an OLSR-based topology-control (TC) approach with the goal of providing expressive performance results for real-life scenarios that are almost identical to the actual environment. Using wireless multihop networks' optimization features to provide communication scalability, a model of efficient methods and processes to enable VoIPs communication over VANET is built in order to assess real-time voice transmission over Internet Protocol applications. The performance of OLSR for VoIP applications in VANET has been examined in several scenarios, utilizing one, two, three, and four hops, while taking into account the quality of Service requirements for VoIP services. OLSR gives adequate behavior in terms of jitter, packet loss, and end-to-end latency, especially when using G.711 codecs. This indicates that OLSR-based TC performed admirably in the four-hop scenario; however, as the scenario's size and the volume of VoVAN data traffic increased, QoS decreased.Particularly when using G.711 codecs, OLSR exhibits appropriate behavior in terms of packet loss, jitter, and end-to-end delays. This indicated that OLSR-based TC had performed admirably in the four-hop scenario but, as the scenario's size and the volume of VoVAN data traffic increased, QoS decreased.

## REFERENCES

[1] Mohammed Elaryh Makki Dafalla, Rania A. Mokhtar, Rashid A. Saeed, Hesham Alhumyani, Abdel-Khalek, Mashael Khayyat. “An optimized link state routing protocol for real-time application over Vehicular Ad-hoc Network”, Alexandria Engineering Journal(2022)61,4541-4556, https://doi.org/10.1016/j.aej.2021.10.013

[2] Ravie Chandren Muniyandi, Mohammad Kamrul Hasan, Mustafa Raad Hammoodi, Ali Maroosi, An Improved Harmony Search Algorithm for Proactive Routing Protocol in VANET, Journal of Advanced Transportation, vol. 2021, Article ID 6641857, 17 pages, 2021. 10.1155/2021/6641857

[3] I. Memon, M.K. Hasan, R.A. Shaikh, J. Nebhen, K.A.A. Bakar, E. Hossain, M.H. Tunio Energy-Efficient Fuzzy Management System for Internet of Things Connected Vehicular Ad Hoc Networks Electronics, 10 (2021), p. 1068, 10.3390/electronics10091068

[4] N. Al-Bulushi, D. Al-Abri, M. Ould-Khaoua and A. Al-Maashri, On the Impact of Static and Mobile Wormhole Attacks on the Performance of MANETs with AODV and OSLR Routing Protocols, 2020 15th IEEE Conference on Industrial Electronics and Applications (ICIEA), 2020, pp. 1064-1069, 10.1109/ICIEA48937.2020.9248412

[5] M.J. Sataraddi, M.S. Kakkasageri Connectivity and Delay

Aware Reliable Routing in Vehicular Ad hoc Networks IEEE International Conference on Advanced Networks and Telecommunications Systems (ANTS), 2019 (2019), pp. 1-5, 10.1109/ANTS47819.2019.9117968

[6] Chai, Y., Zeng, X.J.: Regional condition-aware hybrid routing protocol for hybrid wireless mesh network. Comput. Netw. 148, 120–128 (2019)

[7] X. Zhang, C. Lyu, Z. Shi, D. Li, N.N. Xiong, C.-H. Chi Reliable Multiservice Delivery in Fog-Enabled VANETs: Integrated Misbehavior Detection and Tolerance IEEE Access, 7 (2019), pp. 95762-95778, 10.1109/ACCESS.2019.2928365

[8] A. Mayada, R. A. Saeed, and B. Abuagla, Cross Layer Design Approach for Efficient Data Delivery Based on IEEE 802.11P in Vehicular Ad-Hoc Networks (VANETS) for City Scenarios, International Journal of Africa Nursing Sciences (IJANS), 8, 4, (2018) 10.5121/ijans.2018.8401S

[9] Shakir, A., Alsaqour, R., Abdelhaq, M., Alhussan, A., Othman, M., & Mahdi, A. (2022). Novel Method of Improving Quality of Service for Voice over Internet Protocol Traffic in Mobile Ad Hoc Networks. International Journal of Communication Networks and Information Security (IJCNIS), 11(3). https://doi.org/10.17762/ijcnis.v11i3.4235 (Original work published December 28, 2019)

[10] Z. Hui, P.S. Yuan Analysis and research on OLSR protocol for multi-channel assignment of wireless mesh network Chinese Automation Congress (CAC), 2017 (2017), pp. 2732-2737, 10.1109/CAC.2017.8243240

[11] A. Mayada, R.A. Saeed, A. Babikir Mobility Routing Model for Vehicular Ad-hoc Networks (VANETs) Smart City Scenarios, Vehcom, 9 (2017), pp. 154-161, 10.1016/j.vehcom. 2017.04.003

[12] Said, E., Mohammed, B., Anouar, A. B., Mohamed E., Voice over V ANETs (VoVAN): QoS Performance Analysis of Different Voice CODECs in Urban VANET Scenarios, 2012, International Conference on Multimedia Computing and Systems IEEE, Tangiers, Morocco

[13] Kalpana, G., and Hari, M. S, Performance Analysis of Different Voice CODECs in Integrated VANET-UMTS Wireless Network by using H.323, 2013, Int. J. of Current Eng. and Tech. (IJCET),.3, 5 (2013) 122-129.

[14] A. Shivani, Performance Analysis of OLSR and DSR Routing Protocols for Static Wireless Sensor Networks (WSN), Int. J. of Advanced Research in Comp. Eng. & Tech. (IJARCET) 4 (4) (2015).