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Performance Analysis and Improving Connectivity using Quality of Service-aware Routing Algorithm in Vehicular Network

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ABSTRACT

VANET technology is growing rapidly and with increased users, large data is transmitted. Applications that run over the internet have made users data-hungry. A new field is emerging in the VANET communication technologies which are SDIoV which is a combination of Software Defined Network and Internet of Vehicles theory. The new technology satisfies all requirements of vehicular scenarios over a traditional vehicular network. This paper focuses on the study of routing solutions available in this area and improving these methods. In vehicular networks mostly the shortest path algorithms for routing are focused, this work focuses more on the quality of the path to be selected for forwarding the packets in a vehicular network. While picking the best way among a lot of ways up-and-comer way should fulfill the measurements, for example, signal obstruction and clamor proportion (SINR) and the most noteworthy likelihood of availability. Reproduction results used to approve the predominance of the proposed technique

Key words : IoV, SDN, QRA, AODV, DSRC

1. INTRODUCTION

Nowadays vehicular ad-hoc networks (VANETs) are a promising field of research with many developments of wireless communication and vehicle industries. Likely to Mobile Adhoc networks (MANETs) VANETs use vehicles as mobile nodes and provides communication between nearby vehicle nodes (V2V) and between vehicles to infrastructure (V2I) i.e. nearby roadside unit (RSU) [1, 2]. But their characteristics are different as compared to other networks. As we can see the hubs (vehicles) in VANETs are constrained to street geography while moving, so if the street data is accessible, we can foresee the future situation of a vehicle. Besides, vehicles can manage the cost of noteworthy figuring, correspondence, and detecting capacities just as giving consistent transmission power themselves to help these capacities [2]. Nonetheless, VANETs additionally accompanies a few testing attributes, for example, conceivably enormous scope and high versatility. Hubs in the vehicular condition are considerably more powerful because most vehicles ordinarily are at a rapid and change their position continually. The high portability additionally prompts dynamic

system geography, while the connections between hubs associate and disengage all the time. Moreover, VANETs have a conceivably huge scope which can incorporate numerous members and stretch out over the whole street arrange as shown in figure 1[2, 3]

The framework engineering of vehicular impromptu systems. We will see the Fundamental Segments of VANET. As per the IEEE 1471-2000 and ISO/IEC 42010 design standard rules; we can accomplish the VANETs framework by substances that can be separated into three areas: the versatile space, the foundation space, and the conventional space. [2,4] As is showed up in Figure 1, the versatile territory involves two areas: the vehicle space and the PDA space. The vehicle zone contains a wide scope of vehicles, for instance, vehicles and transports. The mobile phone space incorporates a wide scope of adaptable devices like individual course devices and PDAs [4].

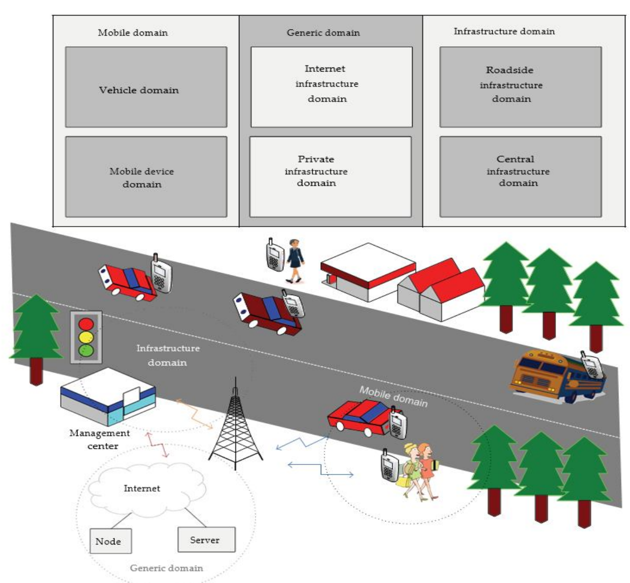

Figure 1: Vehicle and mobile domain

Inside the framework space, there are two areas: the side of the road foundation area and the focal framework area. The side of the road foundation area contains a side of the road unit

elements like traffic signals[5]. The focal framework area contains the foundation of the executives' places, for example, traffic the executive's communities (TMCs) and vehicle the board habitats.

Correspondence types in VANETs can be sorted into four kinds. The classification is firmly identified with VANETs parts as depicted previously. Figure 2 describes the key elements of every correspondence type [6].

1.1. **In-vehicle communication (generic domain):** which is progressively indispensable and critical in VANETs research, suggests the in-vehicle space. In-vehicle a correspondence system can recognize a vehicle's introduction and especially the driver's shortcoming and drowsiness, which is essential for driver and open prosperity [6]

1.2. Vehicle-to-broadband cloud (V2B) communication (infrastructure): suggests that vehicles may confer utilizing far off broadband segments, for instance, 3G/4G. As the broadband cloud may consolidate more traffic information and checking data similarly as infotainment, such a correspondence will be useful for dynamic driver help and vehicle following [2,5].

1.3. Vehicle-to-vehicle (V2V) communication (ad-hoc): In vehicle-to-vehicle communication, each node can share real-time information containing location, speed, and direction.

1.4. Vehicle-to-road infrastructure (V2I) communication (Infrastructure): in V2I communication can broadcast information about traffic conditions to neighboring nodes (Vehicles).

Therefore using both VANET communications (V2V and V2I).real time traffic information can be collected and broadcasts between the nodes[1, 19] .

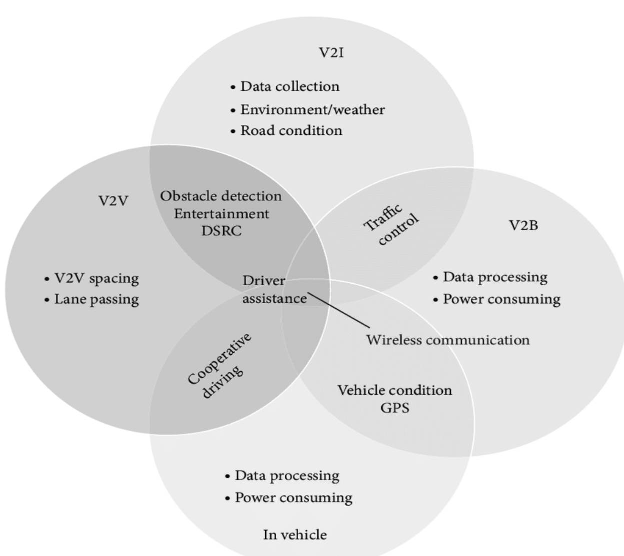

Figure. 2: Communication Types and its functions in VANET

2. INTERNET OF VEHICLE (IoV)

The Internet of Things (IoT) is the course of action of physical articles—contraptions, instruments, vehicles, structures, and different things presented with gear, circuits, programming, sensors, and system openness that connects with these things to amass and trade information. The Internet of Things licenses articles to be recognized and controlled distantly across existing structure, making open doors for the more away from of the physical world into PC based frameworks, and acknowledging improved ampleness and exactness. The chance of a course of action of sharp gadgets was talked about as precisely on time as 1982, with a changed Coke machine at Carnegie Mellon College changing into the essential Internet related mechanical get together, readied to report its stock and whether starting late stacked rewards were cold. Kevin Ashton (conceived in 1968) is an English development pioneer who is known for imagining the articulation "the Internet of Things" to delineate a structure where the Internet is related with the physical world utilizing all inclusive sensors. IoT can relate without human mediation. Some preliminary IoT applications have been presently advanced in therapeutic administrations, transportation (IoV), and vehicle undertakings**.** [4,7].

With the expanding urban populace and the quick extension of urban communities, vehicle proprietorship has been expanding at a fast rate. There has likewise been an expansion in the arrangement of electric vehicles (EV), both completely electric and module half breeds. There is a requirement for better correspondences and interconnectivity among these vehicles because of their versatility. As vehicles develop from basic transportation intends to savvy elements with detecting and correspondence capacities, they become an essential piece of a shrewd city. Shrewd vehicles display five highlights: self-driving, security driving, social driving, electric vehicles, and portable applications [3,7]. The Internet of things (IoT) is an overall framework partner sharp things and engaging them to talk with each other. At whatever point those insightful articles being related over the Web are exclusively vehicles, by then, IoT transforms into the Internet of Vehicles (IoV). Along these lines, IoV is a comprehensive use of IoT in smart transportation. It is envisioned to fill in as a crucial data distinguishing and setting up the phase for keen transportation structures [3]. A vehicle will be a sensor stage, holding information from nature, from various vehicles, from the driver, and using it for the protected course, sullying control, and traffic the chiefs.

IoV permits information gathering and data sharing about vehicles, streets, and environmental factors. Additionally, IoV incorporates information treatment, information processing, and secure information sharing over system stages. Through such information, arrange stages can oversee and direct vehicles in a proficient way, and offer different administrations, for example, mixed media and Web applications. IoV is a coordinated system that underpins shrewd street traffic the board, wise powerful data administration, and savvy vehicle control, showing a run of the mill use of IoT innovation in Clever Transportation Frameworks (ITS) [5].

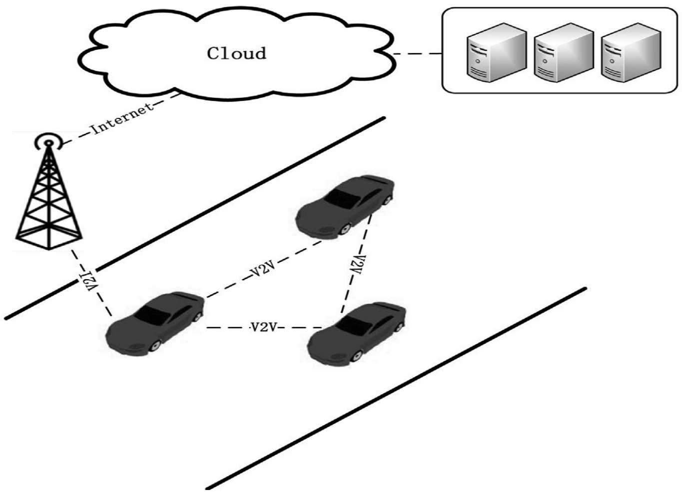

Figure 3: IoV Architecture

IoV is a complex incorporated system framework, which interfaces various individuals inside vehicles, dif¬ferent vehicles, and distinctive natural elements inside cities.IoV comprises of mind-boggling and heterogeneous remote system segments. An overall system architecture has appeared in figure 3. IoV comprises of three layers: vehicles, associations, and workers/mists [11].

3. IoV APPLICATIONS

The utilizations of IoV are very assorted. As indicated by functionalities, we order them into three significant classes [8]. A point by point scientific categorization has appeared in figure 4.

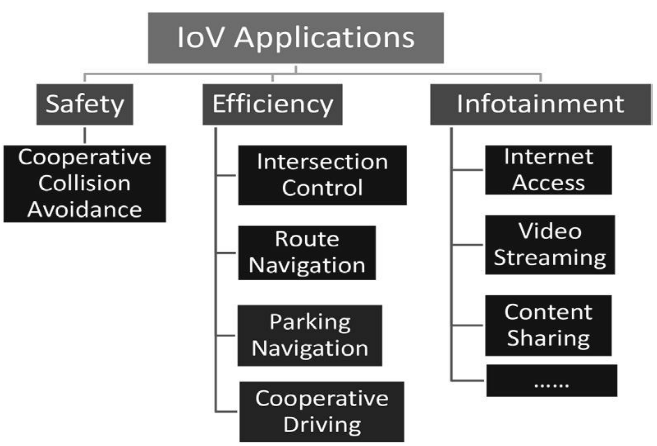

Figure 4: **IoV Applications**

Internet of Vehicles (loV) to be a reality, the vehicles should have the option to work and convey flawlessly. Correspondence between the vehicles and the vehicle proprietors, Correspondence between vehicles [12]. Correspondence among vehicles and an incorporated Worker, and Correspondence between the worker and outsiders like police watch, rescue vehicle, fire-motor, and so forth [9].

4. QRA ALGORITHM

Programming Characterized Internet of Vehicles (IoV) engineering permits vehicles furnished with worldwide situating framework (GPS) collector, onboard route framework, advanced guide, and numerous such savvy gadgets to receive their working boundaries for figuring and correspondence on the fly to improve the general execution of the framework [1]. In SDIoV bundle steering assumes a significant job to make the framework achievable since associated vehicles are reliant on message gotten from another vehicle or Road Side Unit (RSU) in a multi-jump design. Utilization of multi-bounce correspondence in such conditions encourages wide inclusion with a low number of RSU's. Programming characterized arrange design disassociates the control and information planes, accordingly in SDIoV, choice of ideal course is simpler as the brought together controller has a worldwide perspective overall system [17].

We have seen various techniques for SDIoV vehicular situations in the writing audit, however, they have deficiencies as far as discovering steady and solid ways just as progressively suitable RSU to get to a controller [1,13]. It is imperative to build up a versatile steering calculation that favors interface quality and network among vehicles during parcel sending. Also, the RSU choice systems are not vigorous and stable since they don't think about the limit, nature of remote channel, and separation to the RSU's.

The proposed QRA calculation is an ideal directing calculation that forward information parcels towards the most dependable and associated way towards goal. Competitor courses must fulfill the metric, for example, SINR, and must have the best likelihood of availability. The controller will choose the best course among applicant courses utilizing the Laying chicken algorithm(LCA)[1]. Analysts have determined a numerical model for a multimetric choice that could be applied in various convergences. Besides, a bundle transporter hub considers the voracity factor and traffic thickness of street fragment to settle on a choice on the following competitor crossing point. The directing methodology will start by the source vehicle as it sends an affiliation solicitation to a close-by RSU. At that point after accepting a course inquiry from bundle transporter vehicle, a controller is answerable for building system geography-based intermittent reference points and settling on a choice on an ideal way[14]. In the proposed QRA, the system geography is assembled dependent on the unwavering quality and nature of connections. Especially, steering measurements are utilized to quantify loads of connections , as shown in figure 5[18].

4.1. QRA mechanism

In a vehicular ad-hoc network, nodes N is moving in the road map model generated using SUMO. The communication between source S Є N and Destination D Є N is established dynamically. The routers between S and D are r1, r2, r3...rn where n is the number of possible paths. The communication flow between source and destination pair is established dynamically. The chosen source-destination paths are chosen by the centralized controller and spread on the network.

The urban vehicular situation is spoken to as chart model G(i,e) where i is a crossing point and e is the street portion between two convergences. In this way, each ideal course ζ comprises of a lot of crossing points (i1, i2, i3, i4, i5, i6, ..., im) and a set of streets (e1, e2, e3, e4, e5, e6, ..., en) where n=m-1. QRA optimization problem can be written as follows.

$$F(\zeta) = \lambda 1 \times PC(\zeta) + \lambda 2 \times SINR(\zeta) \quad \text{.................... (1)}$$

where,

$$PC(\zeta) = \prod_{i=1}^{n} PC(e)$$

$$SINR(\zeta) = \left(\sum_{i=1}^{n} SINR(ei) - \sum_{i=1}^{n} SINRth(ei)\right) / \sum_{i=1}^{n} SINR(ei)$$

where $SINR(\zeta) >= SINR_{th}(\zeta)$

.....................(2)

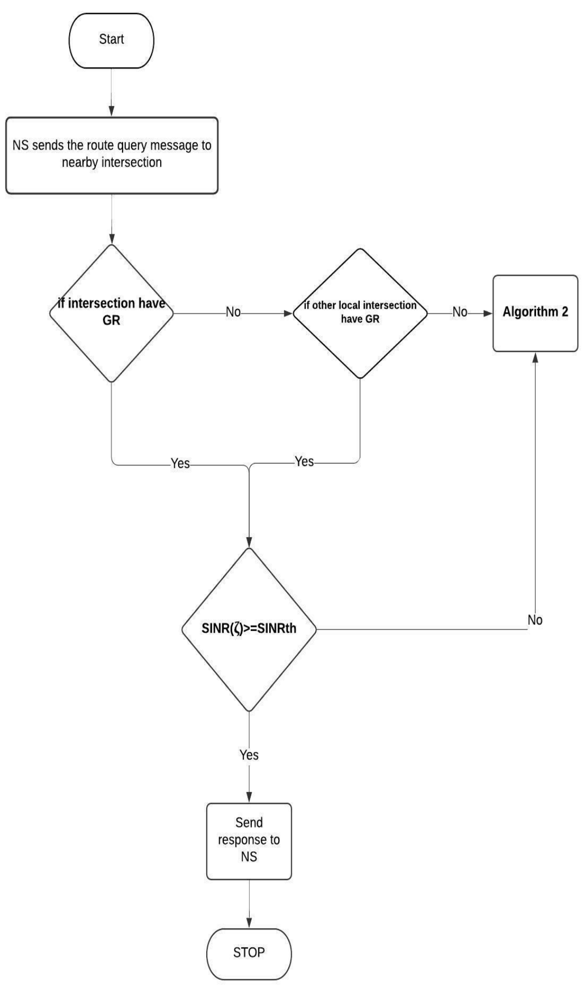

Figure 5: Flowchart of QRA mechanism.

F(ζ) is the target work with a lot of courses ζ from source to destination.

λ1, λ2 = the loads that exactly set in the reproduction and their summation is equivalent to 1.

PC(ζ) = connectivity

SINR(ζ) = reliability of routes.

PC(ei) and SINR(ei) speak to the road's network and connection unwavering quality and SINRth is a predefined limit of SINR. The SINR esteem for a vehicle is figured as follows.

$$SINR = Pi/(PL(d) * (I + Pn)) \quad \text{...................(3)}$$

Where, Pn is the noise power, Pi is the transmission power and I is the impedance power that impacts the transmission signal power of a vehicle. PL(d) addresses the route incident between the source and tolerating vehicles [1].

5. PERFORMANCE EVALUATION

VANETs are a clever framework that permits vehicles to act like hubs, where there is the beginning hub, end hub, and any vehicle between these hubs that can act as the middle of the road hub. To make an association between hubs steering is finished with the assistance of directing convention [16]. Vehicles/hubs in VANET are quick-moving along these lines association between hubs break much of the time.

The proposed system aims at improving the connectivity of the vehicular network, improving communications by reducing message overheads and reducing the packet delay among vehicles and their decision making with the help of the QRA routing algorithm which helps SDN located LCA to make a decision based on provided information[7, 20]. The simulation of the AODV protocol with the proposed system is performed using Network Simulator (NS2) with simulation parameters mentioned in Table 1. Performance is analyzed using the following metrics. aodv.cc and aodv.h files have been modified to implement the proposed protocol [21].

Table 1: Simulation Parameters

Simulator	**Network Simulator 2.35**
Number of nodes	30,45,60,75,90
Area	600m x 600m
Communication range	250m
Packet size	512 bytes
Interface type	Phy/WirelessPhy
Mac type	IEEE 802.11p
Interface queue type	DropTail/Priority Queue
Queue length	50 Packets
Antenna type	Omni Antenna
Propagation type	TwoRayGround
Routing protocols	AODV and QRA
Simulation time	500 Seconds
Speed of vehicles	40Km/hr
Traffic type	UDP

6. SIMULATION RESULTS

In this network topology, there are a total of 30 nodes out of which 4 are considered as RSU's and remaining are mobile nodes i.e. moving vehicles. The path or road between two RSU's is two-way lanes. Figures 7,8,9 and 10 shows simulation results.

Network Topology

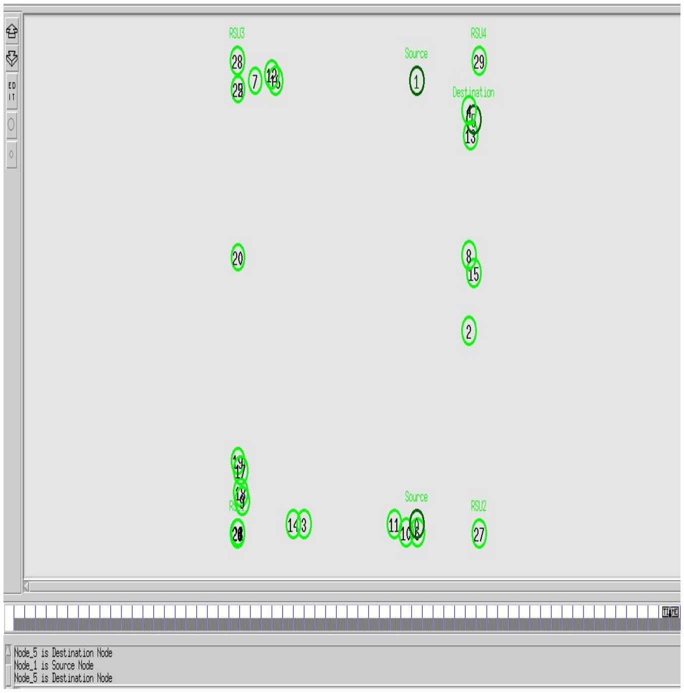

Figure 6: Network animation using NAM (example-for 30 nodes)

Create and simulate a simple vehicular network in a simulator.

1. Calculate the parameters like Packet Delivery Ratio, end-to-end delay in packet transmission for the created scenario.
2. Create and simulate SDN enabled vehicular network in the simulator.
3. The source hub sends a course inquiry to the close by RSU to arrive at a controller in SDIoV.
4. If the course of the predefined goal exists in the controller and if the course doesn't exist in close by RSUs, QRA begins the procedure of ideal course revelation.
5. When there are set of paths available then the local controller applies LCA to find an optimal route.
6. Compute the boundaries like Parcel Conveyance Proportion, start to finish delay in bundle transmission for made situations utilizing QRA.

Table 2: Simulation result for AODV

Parameter	30 nodes	45 nodes	60 nodes	70 nodes	90 nodes
Delay(sec)	0.7476	0.9565	0.5750	1.3412	0.6877
Throughput(kbps)	0.0217	0.0197	0.0222	0.0089	0.0189
Packet delivery ratio(%)	63.943	57.871	64.292	26.169	55.347
Overhead	3.9827	5.8983	7.8738	9.7131	11.8438

Table 3: Simulation result for QRA

Parameter	30 nodes	45 nodes	60 nodes	70 nodes	90 nodes
Delay(sec)	0.5304	0.8163	0.5603	1.1566	0.6234
Throughput (kbps)	0.0230	0.0199	0.02249	0.0116	0.02025
Packet delivery ratio(%)	67.566	58.620	66.017	34.182	59.445
Overhead	3.941	5.841	7.7608	9.695	11.816

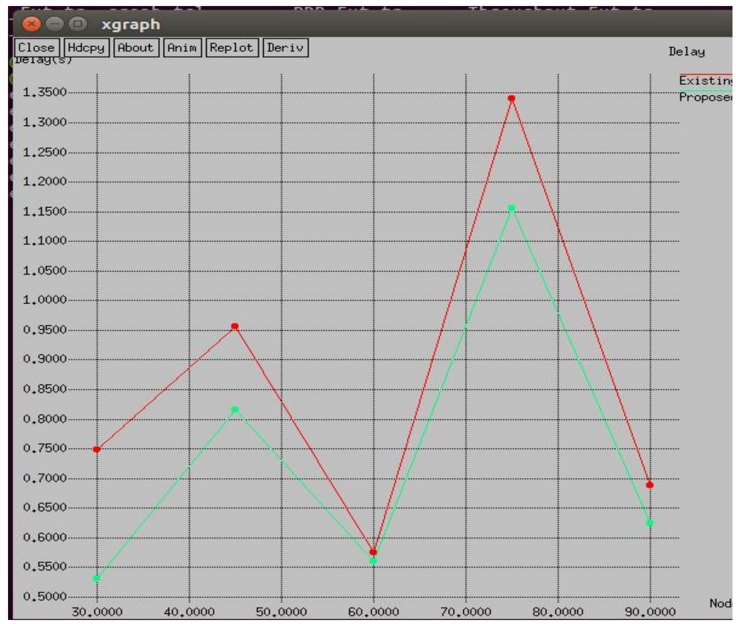

Figure 7: Node vs. Delay

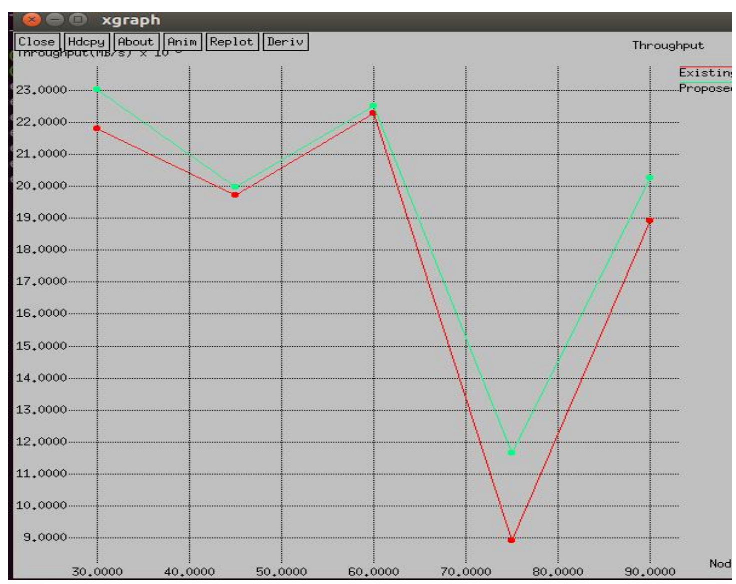

Figure 8: Node vs. Throughput

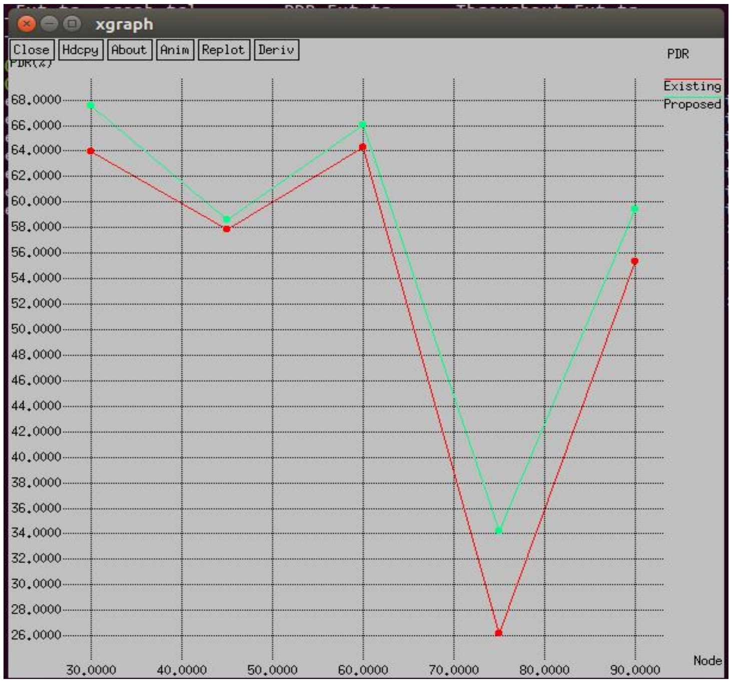

Figure 9: Nodes vs Packet Delivery Ratio

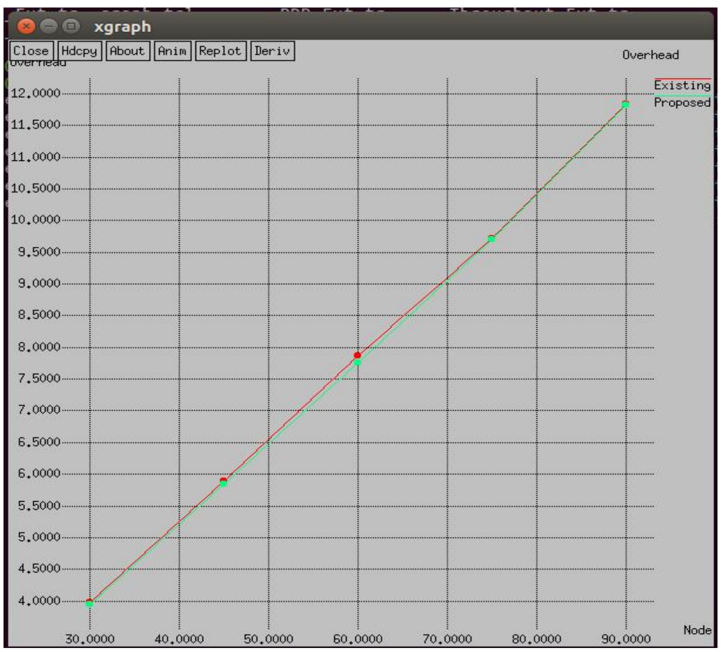

Figure 10: Nodes vs Overhead

7. CONCLUSION

QoS aware routing algorithm (QRA) for vehicular correspondences in city conditions to find the first-rateroute for realities packs through utilizing the opportunity of network thatrelies upon at the on-road part and SINR limits. The QRA utilizes themodified LCA to find the top notch course the different arrangement of stable and progressivelyrelated candidate courses. Multi-rating objective works of art has been applied toselect an intersection factor this is closest to the reason and has progressivelyrelated site guests conditions. The introduction of the proposed procedure isassessed utilizing immense proliferations. Results have shown that the proposed QRA beats the current day directing arrangements regardingparcel transport rate and ordinary start to finish delay. The proposed QRAencourages the main regulator to discover the exact course (presently no longer briefestway) and considers relentless site guests of the paths. Along those lines,the proposed strategy is appropriate for the genuine city vehicular conditionwherein frameworks and real offers are accessible. Moreover, the outcomes haveindicated that the QRA might be appliedfor bundles that require steady and strong realities transport.

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