International Journal of Electronics Engineering (ISSN: 0973-7383)
Volume 13 • Issue 1 pp. 6-11 Jan - June 2021 www.csjournals.com

A survey on Performance evaluation of VANET's Routing protocols

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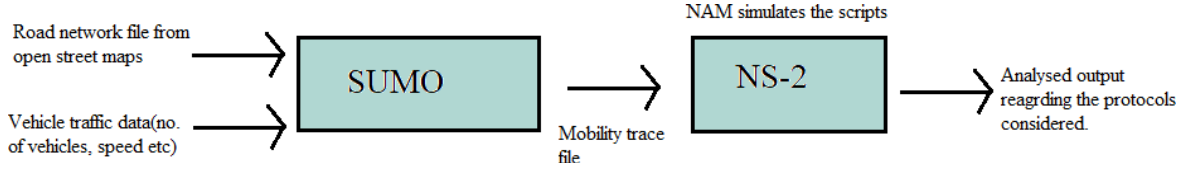
Abstract: Vehicular Adhoc Network (VANETs)has come out as one of the most auspicious technologies for the succeeding years. Vehicular Adhoc Network is a subpart of Mobile Adhoc Network (MANETs) and it follow the principle of MANETs which will create a wireless network of mobile nodes. VANETS will provide quality exchange of data between each of the vehiclesandwiththeroadsideinfrastructures.VANETSareintegratedintomovingvehicleswherevehicularcommunication helps in providing Intelligent Traffic System by enhancing the safety and comfort. The reliability of the routing in the network will have a direct impact on effective communication where in turn the routing depends on type of routing protocol used. The major aim of our survey is to identify the suitable ad-hoc routing protocol that provides efficient communication in VANETs even in extremely high mobility conditions of vehicular nodes. Hence commutable and efficient routing protocols plays a vital role in achieving authentic and adaptable scalable network performance. Networking and mobility component is essential in order to form a VANETs. Many researchers have developed a VANET simulation software that evaluates various routing and emergency warning protocols. In this paper survey is done based on the simulation whichisimplemented by using vehicle monitoring simulator SUMO (Simulation of Urban Mobility) and Network-Simulator NS2, where SUMO is used to simulate traffic density and NS2 is used to simulate communication between vehicular nodes and also the performance of protocols in terms of End to End delay, Packet DeliveryRatio and Throughput wereanalyzed.

Keywords: VANETs, SUMO, NS2, routing protocol.

Introduction

An alternative to traditional wired network, wireless communication is used tremendously which is important in today's communication and new forms of it have turned great to emerging technologies. To support wireless networking in different scenarios a large varieties of technologies have been developed. Since the number of vehiclesareincreasingdaybyday,ithasbecomechallengingforthetrafficsystemtocontrolitanditalsocreates many problems: economically, environmentally and socially too. Expansion of roads and construction can help to solve these difficulties but requires lot of space, constructions and maintenance which is very expensive. Using wireless communication technology for passing information such as damaged roads and its conditions, real time trafficinformation,hazardoussites,accidentsetc., wouldbeareplacementtothetraditionalexpensivemethodand saves a lot of time spent in traffic jams andcongestions[1].As public are dependent on emergency services like ambulance, rescue teams, fire services etc. in cases of heavy traffic the services required may not reach the destination on time and can create a lot of trouble and loss of lives too. VANETs being a part of intelligent transport system uses wireless technology to enhance the system. Therefore, all the emergency services and also other vehicles require real time traffic data which will increase their efficiency to the maximum extent. This creates a smart transportation system.

Vehicle-to-roadside unit (V2R) and vehicle-to-vehicle communications require vehicular ad-hoc networks since the nodes are highly dynamic. Real time and other traffic information is transmitted through these networks. The real-time information aids vehicles find the best path or route to destination, vehicle localization and freeway-traffic-flow management. Once the information is acquired by the vehicular nodes, it can disseminate using various algorithms i.e., protocols to transmit the information to its neighboring nodes efficiently. Forimproving safety, time managements and other environment related aspects, Vehicular Ad-Hoc Networks (VANET) is used which doesn't have a fixed infrastructure and works for high-speed nodes. VANETS simulation system consists of SUMO (vehicular mobility module) and NS2(network simulation module) using these two modules traffic monitoring and analyses will bedone[2].



Basic Block Diagram of Simulation of Routing protocols Using SUMO and NS-2 Simulators

SUMO is one of the software simulators which is multimodal, microscopic and is designed by German aerospace center. It is a continuous road traffic simulator and allows the user to build road topologies according to their needs and also has an option to import real time maps into it. We extractrealtimemapfrom'openstreetmaps'andimportittoSUMO.Trafficiscreatedonitandmobilitypattern for the vehicles will be generated which will be used by the network simulator NS2. SUMO has the capacity to handle many network formats and can operate on large number of vehicles. Thus, by collaborating SUMO with openstreetmap.org simulation is carriedout[3].
NS-2(Network Simulator-2): NS-2 is a software that show the network flow to the user. It is a simulator that describesthe route orthe pathtakenbythepacketsina network.Beinga simulationtool(eventdriven)NS-2has been convenient in studying and understanding the communication networks. There is option for Wired network aswellaswireless networks(e.g.,routingalgorithms,TCP,UDP)bothofwhicharesimulatedusingNS-2.Users ofNS2cansimulatenetworkprotocolsandanalysestheirbehaviorforresearchpurpose.Hence,foritsflexibility and modular nature, NS-2 has proved to be popular and handy in networking research community. Programming languages of NS-2 is C++ andOTcl[7].
There have been several research carried out in the field of vanet applications. Insection I, briefly reviewed some pioneer works carried out to detect best routing protocol. Finally section II illustrates the brief conclusion.

I RELATED WORK

Papers of related topic which are analyzed and the different protocols using different simulators were studied and are described below in brief.

Jani Saida Shaik et.al [1], proposed reactive protocol (AODV) and link-state based protocol (OLSR). AODV was found to perform better than OLSR on considering parameters like E2E Delay, Throughput, Packet loss, Routing overhead and Packet Delivery Ration . As a part of simulation methods, vehicle nodes were increased from 25 to 100 with an increment of 25 to understand the performance of protocols in small and large networks. Variations was also made in traffic load from 1Mbps to 4Mbps. Convergence speed and loop freeness of protocols were also studied. Simulation time was 200s.

Muhammad RizwanGhoriet. al [2], the behavior of AODV (Adhoc On-Demand Distance Vector) and DSR(DynamicSourceRouting)wereevaluatedusingOPNETsimulator.Foraccuracyintheresults,twodifferent VANET scenarios such as simple and complex were considered. Additional RSUs were included in the latter to increased complexity and to obtain better results. Number of nodes were 20 and 40 with maximum speed being 10km/hr. Random Waypoint mobility model with FTP and HTTP traffic types wereconsidered. Throughput and delay were the parameters considered. These parameters were evaluated thrice for 20 vehicles, 40 vehicles and with RSUs as well. Results from analysis showed that AODVs performance was far better than DSR. Also, AODV was found best for video streaming applications.

Suman Malik et. al [3], The findings of a performance review using packet routing protocols for a vehicular mobility model for the city of Bhubaneswar are discussed. This paper proposes two protocols: Dynamic Source Routing(DSR)andOptimizedConnectionStateRoutingProtocol.ThesimulationmethodsusedhereareNetSim andSUMO(SimulationofUrbanMobility).Inthispaper,twotypesofcontactusedhere:V2VandV2I.Toboost the efficiency of VANETs with large networks and high mobility, simulation was planned and conducted to test overall performance parameters such as connection throughput and packet delivery ratio using log-distance pathloss model and nakagami-m fading channel model. As a result, even under extreme conditions, the performance of the combination achieves higher throughput and a high percentage of Packet delivery ratio. In both large and high mobility networks, the DSR protocolperforms in a better manner.

Fihri Mohammed et. al [4],measures the parametric in the form of Packet Delivery Ratio, Average End toEnd Delay, Latency, and the through put. The performance of Adhoc On-Demand(AODV), Dynamic Source Routing(DSR), and Destination-Sequenced Distance Vector (DSDV) routing protocols are estimated. In this case, the vehicles are used as network nodes that can move around freely in a high-speed environment, and MATLAB is used to run the simulation with respect to the parameters. In terms of parameters according to the simulation performance, AODV outperforms DSDV and DSR, with DSDV coming out on top. In the future, simulations for integrated protocols can be performed and compared to existing protocols in terms of delivery cost, packet drop, and so on. Qualnet, NS2, NCTUns, GlomoSim, and other networks can be used forimplementation.

Bashar Barmadaet. al [5], Explains the performance evaluation for several popular VANET protocols and the protocols are AODV, DSR, OLSR, DSDV, GPSR and ZRP using the Nakagami propagation technique for the Auckland area. It is tested for 3 types of traffic that is for low, medium and high traffic. Here, two phases are considered that is a city with a maximum speed of 50 km/hour and a highway with a maximum speed of 100 km/hour. The protocol's performance is measured using three metrics that is packet errorrate,end to enddelay,and thethroughput.SimulationsarecarriedoutusingOMNET++andSUMO.Choosing the appropriate protocol is highly dependent on the application. The results were analyzed and there is no single VANET protocol is suitable for allcases.

Tawfiq NEBBOU et. al [6], Greedy Curve metric Routing Protocol (GCRP) is compared with Greedy PerimeterStatelessRoutingprotocol(GPSR).TypeofcommunicationusedisV2VandV2I.Thesimulationtools used here is OMNET simulator and SUMO. Packet Delivery Rate and End-to-End delay were the metric parameters considered for evaluation. GCRP could select shortest path unlike GPSR. Also, GCRP can manage anddealwithobstaclesthroughitsmechanism.GCRPwasalsofoundtodelivermorepacketsthanGPSR.Result showed that GCRP has a higher PDR (Packet Delivery Ratio) thanGPSR.

Kanza BAYAD et. al [7], Protocols used are DSDV, DSR and AODV and MAC protocols 802.11, 802.11p using NS2 simulator. Packet Delivery Ratio, Normalized Routing Load, Throughput, and Latency are the metric parameters. For each metric, different traffic conditions are simulated by adjusting the group of connections between the vehicles and routing protocols are compared as a result of these changes. The results show that DSR andAODVperformwellintermsofPDRandThroughput.TheoutputofDSDVvarieswiththechangesinmetrics which results in consumption of significant bandwidth. At last, by observing all possible scenarios,IEEE 802.11p is the best suited for high speed data transmission betweenvehicles.

G. RajKumaret. al[8],evaluates and compares the performance of proactive routing protocol with reactive routingprotocolwithrespecttodynamicandstaticconditions.ThepausetimeofbothAODVandOLSRisvaried inreferencetoconstantnumberofnodesinordertoreducemobility.AODVroutingprotocoloutperformsOLSR under static environments in the form of packet delivery ratio and the throughput where an OLSR outperforms AODV under static environments with regards to average energy consumption and overhead. On the whole, the number of nodes considered were 50 and Network Simulator was used for simulationpurpose.

AbdAlrazakTareqRahemet. al [9], the study of various ad-hoc routing methods that is more suitable for differentkindofnetworkiscarriedout.Dependingonthroughputandpacketdeliveryratio,position-basedrouting protocols performs better when compared to traditional based routing. Both highway and city environment were considered where GPSR outperforms AODV in both the circumstances. Whereas ASTAR outperforms both AODV and GPSR in city environment. For finding routes in big city environment ASTAR make use ofanchored based information. Hence ASTAR can be used where large number of nodes and obstacles are involved. On the other hand, GPSR used for different communication between nodes. And it is concluded that different protocols perform differently under different conditions due to the change in vehicle speed driving environment etc. NCTUns (National Chiao Tung University Network Simulator) is used for simulation. Number of nodes considered were 20 with node speed ranging between 20m/s to 30m/s. 1400 bytes of packet size was transmitted with simulation time of 400seconds.

PratibhaKevreet. al [10], evaluates and compares the performance of three grid-based routing protocols that are more suitable for VANETS. DYMO will function similar to that of reactive routing protocols that is used in multi-hop wireless network. It is concluded that AODV outperforms DSR and DYMO transmit mode, receiver mode, idle mode, and residual battery capacity. As AODV consumes less energy compared to DSR and DYMO protocols in grid-based sensor network, AODV is better than the remaining two routing protocols. The number of nodesthatwereconsideredinthesimulationsetupwas33nodeswithasimulationtimeof30seconds.Parameters evaluated were energy consumed in transmit mode, in receiver mode and in idle mode in physical layer. Qualnet 5.2 simulator was used forsimulation.

AniruddhPandeyet.al[11],analyzedthedesignpossibilitiesofAODVimplementation.InAODV the routes are established on demand, until then the network is silent. In AODV sending messages are highly dependent on route reply messages. If route reply is lost a huge quantity of route discovery efforts will bewasted which will affect the routing performance. Hence a source node should initiate a new route detection that which establishesarouteendtoend.Numberofnodesconsidered intopographywas250nodesalongwith6roadlanes. The simulation time was observed to be 3000 simulation seconds with the node speed of 15m/s. Packet size is considered to be 150. SUMO and OMNET++ simulator tools were used for simulation combined with veins to obtainarealisticmobilitymoduleforVANETS.Variousparameterssuchasthroughputofsendingandreceiving packets, throughput of dropping packets wereevaluated.

SumanMaliket.al[12],evaluatesthefunctioningofAODV, DSRroutingprotocolsinVehicle to Vehicle and Vehicle to Infrastructure communication. Network simulator NetSim10.2 and SUMO were the simulators used. VANET

scenario was built for Bhubaneshwar city map. Number of vehicles were 20,40 and 60 with speed of 20m/s and was simulated for 400s. Rayleigh and Nakagami radio propagation model were taken into consideration. Throughput, PDR, Average E2E Delay and overhead transmission were the parameters considered for evaluation. Results showed that DSR outperformed AODV when considering aboveparameters.

Seema Pahalet. al [13], QualNet5.3 simulator used for the evaluation of DSR, OLSR, DYMO and ZRP was performed. 100 nodes were created on 1500mX1500m area size. In WSN, IPv4 was considered with traffic typeof Constant bit rate. Average throughput, end to end delay,jitter, total packet received was measured as performance metrics. Results made it clear the different protocols performed well in different scenarios. For example, DYMO performed well in high mobility scenario, OLSR showed least delay, DSR was preferred for throughput etc.

Raj K Jaiswal et. al [14], is based on the AODV routing protocol with OLSR on two different road network situations. Network simulators Vehicular Ad-hoc Networks Mobility Simulator (VANETMO-BISIM) and NS-2.35 were the simulators used. The basic goal of this work is to analyze the applications of AODV and OLSR protocols in VANET with different traffic and transmission ranges. AODV, OLSR protocols are not stable for PDR and the throughput as compared to vehicle density and data generation rate. Based on results obtained for the entire city road network scenario, AODV, OLSR protocols were not suitable for VANET as endurance with vehicle density and data generation rate were not satisfactory with VANET applications.

BaduguSamathaet. al [15], is based on the behavior of vehicular network in different scenario andanalysestheperformancemetricsoftheVANETlikethroughput,Endtoenddelay,andpacketdeliveryratio. Network simulators NS-2 and SUMO were the simulators used. The main uniqueness of this paper is the key parameters of 802.11p standard in ns-2 are to implement, and prepare the realistic vehicular mobility model by SUMO. The average packet success ratio and throughput of VANET in Real Traffic environments for various routing protocols were analysed. Among DSR, AODV and DSDV it was observed that DSR outperformed performed better than therest.

L. Raja et.al[16], evaluates and compares the performance of AODV routing protocol and analyses its effects in theperformancemetricssuch asPacketDeliveryRation, EndtoEndDelay, Network Overhead,Throughput, and Energy Consumption are verified using the vehicle nodes, Time of simulation, Packet Size and Mobility. The results were projected by varying the simulation time, packet size and mobility using trace files. Therefore, it was found that AODV has its excellent support for multiple routes andmulticasting.

Er. Abhishek Sengaret. al [17], evaluates the performance of AODV, DSDV routing protocols on the basis of various network metrics such as throughput, packet delivery ratio and Routing Overhead.ThePerformanceevaluationwasdoneusingNS2simulation tool.Simulationtimewas60sec. The number of vehicle nodes was increased during the transmission and throughput decreased. AODV's throughput was betterthanDSDVbecauseofitsconsistentperformance.AODVhadminimumroutingoverheadwereDSDVhad maximum routing overhead. AODV delivered the highest packet delivery ratio were DSDV delivered lowest packet delivery ratio. Therefore, it was found that the overall performance of AODV was better thanDSDV.

AwosKh.Aliet.al[18],providesathoroughevaluationandanalysisofroutingprotocolsAODV,OLSR,and GPSR with urban surrounding setup. For communication model 801.11p was employed as a mac layer. Results show that GPSR has shortest end to end delay where as AODV takes much time to deliver the packets under network load. GPSR shows substandard performance in terms of DBL. When DBL and packet delivery ratio are consideredaslowloadnetwork. The OLSRoutperforms thanAODV,GPSR.Inspiteofpoorperformanceunderlow network load, stable performance is observed under medium and high network load in GPSR protocol when compared to AODV and OLSR. It is observed that by using parameter DBL, OLSR outperformed AODV and GPSR. Because in busy Mac layer OLSR packet drops are more common. With GPSR stable performance is achieved by the network and the delay is also short. In the simulation setup 100 vehicles were considered with a maximum speed of 20m/s along with 13 roadside Infrastructures. In order to simulate fading in wireless channel Nakagami propagation is supplied as a propagation model. Quantitative metrics DBL packet delivery ratio and end to end were evaluated. And SUMO (Simulation of Urban Mobility) was used as a traffic simulator.

Table I : Comparative Table For Performance Evaluation Of Routing Protocols

SL.NO.	PROTOCOL/PROTOCOLS ANALYSED	SOFTWARE USED	PARAMETERS	BEST PROTOCOL
Jani Saida Shaik et.al [1],	AODV and OLSR	Network Simulator-2	E2E Delay, Throughput, Packet loss, PDR and Overhead	AODV
Muhammad RizwanGhori et. al [2]	AODV and DSR	OPNET	Throughput and Delay	AODV
Suman Malik et. al [3],	DSR and OLSR	NetSim and SUMO	Link Throughput and PDR	DSR
Fihri Mohammed et. al [4],	DSR, AODV and DSDV	MATLAB	Average End to End Delay, PDR, throughput and Latency	AODV
Bashar Barmada et. al [5],	AODV, ZRP, DSDV, OLSR, GPSR and DSR	OMNET++ and SUMO	Throughput, Packer Error Rate and End to End Delay	None of the protocols suits all the cases
Tawfiq NEBBOU et. al [6],	GCRP and GPSR	OMNET and SUMO	Packet Delivery Ratio and End to End Delay	GCRP
Kanza BAYAD et. al [7]	DSDV, DSR andAODV (with IEEE802.11 and IEEE802.11pstandards)	NS-2	Packet Delivery Ratio, Normalised Routing Load, Throughput and Latency	different protocols performed well in different cases and all performed well in IEEE802.11p
G. RajKumar et. al [8],	AODV and OLSR	Network Simulator	Packet Delivery Ratio, overhead, Average energy consumption, Throughput	AODV and OLSR performs differently in different cases.
AbdAlrazakTareqRahem et. al [9],	ASTAR, GPSR and AODV	NCTUns (National Chiao Tung university Network Simulator)	Throughput and Packet Delivery Ratio	Different protocols performed well in different scenario
PratibhaKevre et. al [10],	AODV, DSR and DYMO	QualNet 5.2	Energy consumption in transmit mode, receiver mode and idle mode.	AODV
AniruddhPandey et.al[11],	AODV	SUMO and OMNET++	Throughput of sending and receiving packets and throughput of dropping packets	-
SumanMaliket.al [12]	AODV and DSR	NetSim10.2 and SUMO	Throughput, Overhead Transmission, Average End to	DSR

II CONCLUSION

For the Vehicular ad-hoc network to perform optimally, a suitable routing protocol must be introduced in it. This paper briefs about the analysis of various combination of routing protocols suitable in VANET scenario. From related work, which estimated different protocols by using several parameters, for example, packet delivery ratio, throughput, overhead, end to end delay etc. with softwaresuchasNS-

2,OPNET,NetSimetc,itiscomprehensible that AODV protocol performed optimal in majority of the cases. But the disadvantage of this protocols is that, there will be a delay since it finds routes only whenever necessary and doesn't store the routes beforehand.Some work also mentions that no protocols are suitable in all scenarios. Different protocols perform well in different scenario. Hence, protocols must be chosen depending on therequirements.

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