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ANALYSIS OF VANETS ROUTING PROTOCOLS

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Abstract

Day to day the number of vehicles on roads increasing drastically and results in more congestion and hence more number of accidents. Intelligent Transportation Systems initiates the vehicular ad-hoc networks, in which vehicles are equipped with a number of sensors, computing devices, camera, radar etcetera and are capable ofcommunicating the information among other smart vehicles and roadside units and guarantees improvement of traffic conditions and safety. IEEE802.11p protocol can be used to link vehicles to the internet with or without existing infrastructure. Here routing of packets is a challenging task as the nodes are mobile. The objective ofthis paper is to illustrate the working of existing standard topology based routing protocols like DSDV, OLSR and AODV with simulation results in terms of packet delivery ratio, end to end delay and jitter delay fordifferent node densities of network. Simulations are carried out using NS3 and SUMO.

Keywords — VANET, MANET, DSRC, DSDV, OLSR, AODV.

Introduction

MANET is a type of ad hoc network that consist of a set of mobile nodes that are wirelessly connected in a self-configuring and self-healing manner without having a fixed infrastructure. It does not have any centralizedcoordinator for route establishment. As MANET nodes move randomly, topology of the network changesfrequently. Each mobile node behaves as a router as they forward data to other specified nodes in the network. Each mobile node in the network has a predefined distance range for data transmission. It is well suited forspecific applications like battlefield environment, emergency response environment, sensor networks, vehicularnetworks, etcetera [1, 2].Now-a-days each person uses his/her own transportation to reach their destinations. Due to inefficient drivers, traffic congestion, violation of traffic laws, inadequate road information, increased population, and lack ofsecurity infrastructure many accidents are taking place. So reducing traffic congestion and improving roadsafety are the main problems to address for human well-being.

VANET is a subset of ad-hoc networks that contains nodes as vehicles. It has three

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components namely Onboard units (OBUs) Road side units (RSUs) and trusted authority (TA). OBUs are placed inside the vehicles,which includes sensors, GPS and other devices. It acts as both transmitter and receiver. RSUs are placed besidesthe junctions, which collects the information from vehicles and broadcast that information to its nearest vehicles with in its range. TA is a third party which provides the security of authentic users. The main purpose of thesenetworks is to send the safety related messages to drivers. The communication range of DSRC is from 100m to1Km; within this range the vehicles communicate both V2V and V2I with the speed of 6 to 27 Mbps data rate. It delivers actual traffic information timely, which helps in improving efficiency of the network. Later, theDSRC standard was renamed as Wireless Access in Vehicular Environments (WAVE), which is called theIEEE 802.11p standard [3]. In V2V communication the vehicles exchange information like “Go slow”, “Lane change”, “object to left side” etcetera to other vehicles with in its communication vicinity. In addition to thesemessages if the priority of vehicle is also informed then the high priority vehicles like ambulance will beprovided with clear route [4, 5, 6].

The rest of the paper is segregated as follows: Section II gives the Types of Routing protocols. Section IIIDescribes the Routing protocols, Section IV depicts the performance metrics of the VANET, Section V insteadthe Simulation Parameters & Methodology and section VI Simulation Results and Discussion and section VIIconcludes the paper.

II. **TYPES OF VANET ROUTING PROTOCOLS**

The process of picking the optimal vehicle or vehicles in the network to forward data in VANETs is known asvehicle routing. Although nodes are often picked based on their proximity to the destination, the optimalforwarding node is not necessarily the one closest to it.

Topology based routing: Routes are formed prior to data transfer with the help of control packets. As a result,every node of the network has the complete knowledge of network topology prior to data transfer. Proactive,Reactive and Hybrid routing protocols are the subtypes of this routing technique. In Proactive routing everynode holds a table which contains the total network’s topological information and all nodes update this table periodically. Whereas, in reactive or demand-driven routing, routes are created on demand i.e. when necessary.

The protocols DSDV and OLSR are proactive whereas the DSR and AODV are reactive type. Position-based routing is one type of routing algorithms. They all have the ability to pick the next hop based ongeographic location information. Without any map knowledge, the packet is sent to the one hop neighbour whois closest to the destination. Position-based routing is widely classified into three types: Non-Delay tolerant,delay-tolerant protocols and hybrid. DTN protocols are suitable for the applications which don’t demand high speed and non-DTN protocols are used for the application which seeks high speed. Hybrid routing protocoluses both non-DTN and DTN modes for packet delivery based on the conditions [3].

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III. DESCRIPTION OF ROUTING PROTOCOLS

1) Destination Sequenced Distance Vector (DSDV) RoutingDSDV protocol works based upon the Bellman ford algorithm. In this each node maintain and update its own routing table, which includes feasible destination nodes, hop count to reach each destination node and sequencenumber. With the help of Sequence number one can easily differentiate the old and fresh routes and can avoidthe routing loop problem. If there is any change in network topology all nodes get updates immediately. InDSDV, each mobile node advertises via broadcasting/ multicasting its routing table to the neighbours with in its communication vicinity. Routing updates can be done by either full-dump or incremental update. Routingtables in DSDV are updated on a regular basis, and there is another routing table that contains the settling time,which is a reference for the node to advertise update information [7]. Links between nodes in the network maybe broken in some cases due to their mobility. In that case, the infinity metric is assigned to all routes passing through that node, and a new sequence number is broadcast throughout the network. This mechanism ensuresthat routes are not looped; however, it introduces route fluctuation when multiple nodes transmit update packetsat irregular time intervals. This issue can be solved by waiting for a predefined time by each node (averagesettling time) from a route-settling-time-table before broadcasting any route update message.

2) Optimized Link State Routing (OLSR)OLSR is an optimal of the traditional Link State Routing (LSR) algorithm. In LSR [8], each MH advertises itslink state data to all its neighbours, resulting in a lot of redundancy. The OLSR, on the other hand, avoids these unnecessary transmissions by selecting specific nodes to re-transmit link state information [9]. Each networknode determines which of its neighbours can flood the link state packet. These preferred neighbour nodes arereferred to as Multi-Point Relay (MPR) nodes. As a result, rather than blind flooding, packets are now onlyretransmitted by MRP nodes. In OLSR, topological information is updated on a regular basis. OLSR wasdesigned to function independently of other protocols.

3) Ad-hoc On-demand Distance Vector (AODV) RoutingIt is a one of the On-Demand/Reactive routing protocol used widely in MANETs. AODV protocol runs in two phases namely, route discovery and route maintenance mechanism. In AODV, the source node will not carry thecomplete path and each node maintains the route cache to save the information about the reachable destinations.

When a node wants to transmit the packet to the destination, the sender node initiates to broadcast the RREQpacket. If any one of the neighbouring nodes which had received the RREQ packet and knows the path fordestination, then it sends RREP packet through a selected path to the sender node. Otherwise, they rebroadcastsRREQ packet [10]. If the RREQ is received multiple times, the duplicate copies are discarded. When route request is forwarded, the address of the previous node and its broadcast ID are stored. If a node moves away orlink fails from the established path then the broken path has to be intimated by sending Route Error message(RERR) packet to the sender node [11, 12].

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IV. PERFORMANCE METRICS

The network performance of the DSDV, AODV, and OLSR routing protocols is compared in terms of thefollowing performance metrics.

1. PDR: It represents the ratio of total number of successfully received data packets to the total number oftransmitted packets.

PDR = $Totalnumberof Packetsreceived sucessfully Totalnumberof packetstransmitted$

2. E2E Delay: The total amount of time required to deliver a data packet from the transmitting node to thereceiving node is specified as the E2E Delay.
3. E2E Jitter Delay: It is defined as variation in the delay of received packets.

V. METHODOLOGY OF PARAMETERS

Table 1: parameters

Parameter	Value(s)
Simulator	NS-3.27
MAC Protocol	IEEE802.11P
Mobile Nodes	20,63 and 162
Node Speed	30 m/s
Area	300m*1500m
Packet Size	64 bytes
Simulation Time	16 and 20 seconds
Transmit power	20 dBm
Routing Protocols	DSDV, OLSR and AODV
Mobility Model	Random Waypoint

Step 1. Generate the traffic scenario of selected area using Cars, Trucks and Pedestrians with the help ofSUMO (Simulator for Urban Mobility).
Step 2. Convert the osm.sumocfg file into .xml file.
Step 3. Convert this .xml file into .tcl (Tool Command Language) file (mobility.tcl).
Step 4. Assign this .tcl file to the “vanet routing compare.cc” file of NS3.
Step 5. Run the code for different protocols (DSDV, OLSR, and AODV) and generate the .log file, .mob file,.csv file for each traffic density generator Scenario.
Step6. Using the .csv file of corresponding protocol, generated graphs for Different Metrics with respect tosimulation time with the help of GNU PLOT and Microsoft Excel.

VI. RESULTS AND DISCUSSION

The simulations are performed using NS-3.27 and results are generated for three different traffic densities withof 20, 63 and 162 nodes per selected area respectively.

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1. Packet Delivery Ratio:
   Packet delivery ratio of OLSR, AODV and DSDV is is observed that the PDR is increasing from 20 node case to 63 node case, as more number of packets can be transferred when number ofnodes are increasing. It is also observed that the PDR is decreasing from 63 nodes case to 162 nodes case. Dueto increased congestion. For all scenarios OLSR offers high constant PDR due to its multipoint relay scheme. As DSDV need to update the routing tables irrespective of the need and hence some time will be wasted. That isthe reason the PDR is less compared to DSDV

2. End-to-End Delay:
   End-to-End Delay of OLSR, AODV, and DSDV is shown in figure3, from fig3 it is observed low traffic density(20 nodes), moderate traffic density (63 nodes), and high traffic density (162 nodes). As the numbers of nodes are increasing the end-end delay of AODV is increasing as it needs more time toestablish a route on demand for more number of nodes. OLSR and DSDV offers negligible delay as multiple relay nodes are available and updated routing table respectively.

3. End-to-End Jitter Delay:
   End-to-End Jitter Delay of OLSR, AODV, and DSDV is shown in figure 4, various traffic density scenarios. Asthe number of nodes are increasing the end-end jitter delay of AODV is increasing as it needs more time to establish a route on demand for more number of nodes and this time is also various based on topology. OLSR and DSDV offers negligible delay as multiple relay nodes are available and updated routing table respectively.

VII. CONCLUSION

Nowadays the VANETs are becoming more popular in transportation due to their features, which ensuresecurity of vehicles and hence human lives. In this paper, we examined the Performance of DSDV, AODV, andOLSR routing protocols in terms of Packet Delivery Ratio, End-to-End Delay, and E2E Jitter Delay for varioustraffic densities VANETs. From the results it is clear that OLSR routing protocol provides high packet deliveryratio, low jitter delay and low end-to-end delay for all the cases. So the OLSR routing protocol is best suited fordifferent node densities. We observed that OLSR is an effective choice for ad hoc network establishment. It willbe beneficial for applications such as emergency Services, and battlefield communications. The reason foroutstanding performance of OLSR routing protocol with respect to AODV and DSDV is due to MultipointRelay (MPR) technique, which ensures not only efficient and scalable routing but also avoids extra networkoverhead caused by signalling messages.

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