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Routing Overhead Comparison on AODV Based Routing Protocols in Vehicular Adhoc Network

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Abstract: Vehicular Ad hoc Network(VANET) is a specific type of Mobile Ad hoc Network(MANET) in which the nodes(vehicles) are moving with high speeds. VANET is one of important issues in building smart city. The first popular routing protocol for MANET is AODV. After that there are various papers that propose the modification of AODV. This paper focus on routing overhead comparison among AODV based routing protocols. The simulation was done by using Network Simulator 2 (NS2) and MOVE (MObility model generator for VEhicular networks) over SUMO (Simulation of Urban Mobility).

Keywords: VNET, AODV, MOVE, SUMO ,NS2

1. INTRODUCTION

Rather than the Mobile Ad hoc communication the direct communication between vehicles is relatively new approach. The development of VANET provides some attractive services such as comfort applications and safety applications[1].

Comfort application improves passenger comfort and traffic efficiency and/or optimizes the route to a destination. Examples for this category are: traffic information system, weather information, gas station or restaurant location and price information, and interactive communication such as Internet access or music download.

Safety application gives the safety of passengers by exchanging safety relevant information via inter-vehicle Communication (IVC). The information is either presented to the driver or used to activate an actuator of an active safety system. Example applications of this class are: emergency warning system, lane-changing assistant, intersection coordination, traffic sign/signal violation warning, and road-condition warning.

VANET has many challenges including service differentiation, admission control, efficient broadcasting, geographical routing,etc.

The paper is organized as follows: The next section discusses three routing protocols: AODV, MAODV and AOMDV. Section Three shows simulation results. Section Four explains the characteristic simulation tools. Finally, the last section concludes the comparison analysis of those three protocols.

2. RELATED WORK

Several research studies have been carried out to enhance the routing on VANET. The performance analysis of the protocols is the major step before selecting a particular routing protocol. In fact, path routing and protocol selection are the primary strategies to design any vehicular ad-hoc network considering data delivery, data integrity and especially time delivery.

The authors illustrate the differences between AODV, DSR and DSDV based on TCP and CBR connection with various network parameters[2]. The performance of these three routing protocols shows some differences in low and high node density. Indeed, in low density with low pause time, the PDR of CBR connection for these routing protocols is low. While for TCP connection, the PDR is high for DSR and average for DSDV.

Performance analysis on VANET routing protocols was done to identify which routing method had better performance in highly mobile environment of VANET [3]. The authors conclude that cluster-based routing protocols with short interval values provide better Packet Delivery Ratio, as their routing table is updated quickly and one node is responsible to deliver messages to all nodes of the clusters. They observe that OLSR and AODV routing protocols have higher end-to-end delay than DYMO. MOBIC and AMACAD again outperforms the other routing protocols when the node density increases in this scenario.

3. AODV BASED ROUTING PROTOCOLS

3.1 Ad-hoc On-demand Distance Vector (AODV)

AODV is a combination of on-demand and distance vector i.e. hop-to-hop routing methodology [4]. When a node needs to know a route to a specific destination it creates a ROUTE REQUEST. Next the route request is forwarded by intermediate nodes which also create a reverse route for itself for destination. When the request reaches a node with route to destination it creates again a REPLY which contains the number of hops that are require to reach the destination. All nodes that participate in forwarding this reply to the source node create a forward route to destination. This route created from each node from source to destination is a hop-by-hop state and not the entire route as in source routing.

3.2 Multicast Ad hoc On-demand Distance Vector Routing Protocol (MAODV)

In [5], the authors extend Ad-hoc On-Demand Distance Vector Routing (AODV), an algorithm for the operation of such ad-hoc networks to offer novel multicast capabilities which follow naturally from the way AODV establishes unicast routes. AODV builds multicast trees as needed (i.e on-demand) to connect multicast group members. Control of the multicast tree is distributed so that there is no single point of failure. AODV provides loop-free routes for both unicast and multicast even while repairing broken links.

3.3 Adhoc Multipath on Demand Distance Vector Routing(AOMDV)

AOMDV, on the other hand, is a multi-path routing protocol[6] . It is an extension to AODV and also provides two main services i.e. route discovery and maintenance. Unlike AODV, every RREP is being considered by the source node and thus multiple paths discovered in one route discovery. Being the hop-by-hop routing protocol, the intermediate node maintains multiple path entries in their respective routing table. As an optimization measure, by default the difference between primary and an alternate path is equal to 1 hop. The route entry table at each node also contains a list of next hop along with the corresponding hop counts. Every node maintains an advertised hop count for the destination. Advertised hop count defined as the "Maximum hop count for all the paths". Route advertisements of the destination are sent using this hop count. An alternate path to the destination is accepted by a node if the hop count is less than the advertised hop count for the destination.

4. SIMULATION TOOLS

The key concept for VANET simulations is a real world vehicular mobility model which will ensures conclusions drawn from simulation experiments will carry through to real world deployments. Simulation of Urban Mobility (SUMO) allows users to easily generate real world mobility models for VANET simulations[7]. SUMO is conceived to simulate a traffic road network of the size of a city.

As the simulation is multi-modal, which means that not only are car movements within the city modelled, but also public transport systems on the street network, including alternative train networks, the atomic part of the simulation is a single human being. This human being is described by a departure time and the route he/she takes which again is made up of subroutes that describe a single traffic modality.

MOVE [8] tool is used to facilitate users to rapidly generate realistic mobility models for VANET simulations. MOVE is currently implemented in java and is built on top of an open source micro-traffic simulator SUMO. By providing a set of Graphical User Interfaces that automate the simulation script generation, MOVE allows the user to quickly generate realistic simulation scenarios without the hassle of writing simulation scripts as well as learning about the internal details of the simulator. The output of MOVE is a mobility trace file that contains information about realistic vehicle movements which can be immediately used by popular simulation tools such as NS2.

5. SIMULATION RESULTS

Both, routing and data packets have to share the same network bandwidth most of the times, and hence, routing packets are considered to be an overhead in the network. This overhead is called routing overhead. Routing overhead can be calculated the number of packets including sending and receiving packets by sending packets.

Table 1 shows the parameters that were used in simulation.

Table 1. Simulation parameters

Parameter	Value
Channel Type	Wireless
Network Simulator	NS2.35
Routing Protocol	AODV, MAODV, AOMDV
Simulation Time	1050s
Number of Nodes	50, 100, 150,200
Mobility Model	MOVE, SUMO
Maximum Average Speed	20 to 50 (km/h)
Packet size	512 bytes

To make tests, city maps are generated using MOVE software. Figure 1 shows the map used for this process.

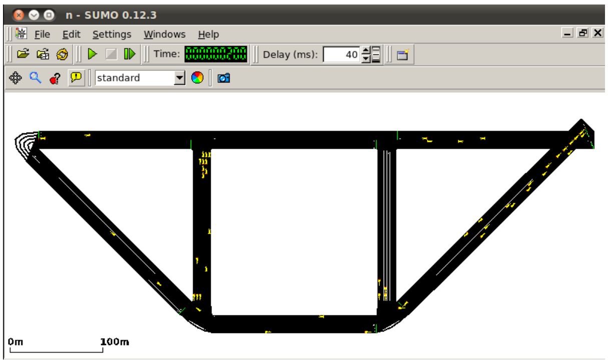

Figure 1. Mobility Model using SUMO

Based on the map shown in Figure 1, the communications between vehicles are implemented in NS2. For implementation, "tcl" script files are written and compiled.

The analysis is taken for three routing protocols: AODV, MAODV and AOMDV. After compiling those script files in NS2, the relevant "nam" files(*.nam) and "trace" files (*.tr) are generated.

The "nam" files can be used to simulate the packet communication between vehicles. The "trace" files are used to generate values of network performance parameters such as packet delivery ratio(PDR), throughput, dropout, etc. The "awk" script file as shown in Figure 2 is written to generate parameter values. With the command "gawk –f parameters.awk *.tr > *.txt" , the output values are produced in "*.txt" file.

```
 BEGIN {
       sends=0;
       routing_packets=0.0;
       }
{
  time = $3;
  packet_id = $41;

  # CALCULATE PACKET DELIVERY FRACTION
  if (( $1 == "s") &&  ( $35 == "tcp" ) && ( $19=="AGT" )) {  sends++; }

  # CALCULATE TOTAL dsr OVERHEAD
  if (($1 == "s" || $1 == "f") && $19 == "RTR" && $35 =="DSDV")
routing_packets++;


     RO = routing_packets/sends;     #routing overhead

     printf("RoutingOverheads = %.2f\n",RO);
     #printf("No. of dropped data (bytes)   = %d\n",droppedBytes);

}
awk ▾   Tab Width: 8 ▾   Ln 23, Col 1   INS
```

Figure2 . "awk" script to produce routing overhead(RO)

Table 2. Routing Overhead comparison

Number of Nodes/Vehicles	AODV	MAODV	AOMDV
50	23002	24030	24852
100	30021	34178	32873
150	39552	39650	39781
200	43777	43800	45311

The routing overhead comparison between three protocols is shown in Table 2. According to Table 2, AODV has the least routing overhead in various numbers of nodes. MAODV and AOMDV produce more routing overhead than that of AODV. However, the routing overheads are nearly the same when the number of node becomes larger. Since the modified protocols are addressed to reduce transmission time, they can provide high speeds. Therefore the modified protocols are suitable for large, complex traffic area.

6. CONCLUSION

This paper presents the routing overhead comparison of three protocols in VANET. The location area is implemented in SUMO. The simulation and analysis are taken in NS2. According to analysis results, AODV has the least routing overheads among three protocols. However, the routing overheads become nearly the same for the large communication area. It can be concluded that the modified AODV protocols are suitable for large and high speed communications.

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