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Performance Analysis of AODV and DSDV in Simulation Based Map

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Abstract **In recent days Inter-Vehicle communication has fascinated many research communities and automotive industries .With the introduction of inter-vehicle communication it would be possible for vehicles to communicate with each other and thus this functionality will provide intelligent transportation system as well as many assistant services for drivers and passengers. Vehicular ad-hoc network is an enhanced form of mobile ad-hoc network where vehicles are nodes providing communication capabilities among vehicles. Routing protocols for VANET is a major issue of concern for researchers because of highly dynamic, large, high mobility nature of VANET. Main objective of this paper is to analyze and compare behavior of AODV and DSDV in given scenario with the help of simulators which allow users to generate real world mobility models for VANET simulations. For this purpose simulators NS-2, SUMO,MOVE have been used.**

Keywords ITS, VANET, AODV, DSR, MOVE, SUMO, NS2

1. INTRODUCTION

Because of high traffic congestion and large number of road accidents concept of intelligent transportation system has fascinated many research communities and automotive industries. Vehicular ad-hoc network (VANET) is a name given to ITS. VANET is an enhanced form of mobile ad-hoc network where vehicles are communicating nodes. Recent development in wireless technology and automotive industries makes it possible for vehicles to communicate with each other. Introduction of VANET will significantly reduce both traffic congestion and vehicles crashes which are serious issues throughout the world. In recent days many countries have recognized the importance of VANET . In USA, the Federal Communication Commissions (FCC) has allotted 75MHz of licensed spectrum at 5.9GHz as the DSRC for VANET. In Europe , the Commission of the European Communities has allotted 5875-5905MHz frequency band for road safety related applications. In Japan, the deployment of Electronic Toll Collection (ETC) has allotted 5.8GHZ spectrum. IEEE has also approved IEEE 802.11p standard for wireless access in vehicular environment. Major issue associated with VANET is designing of an appropriate routing protocol because of various issues [2] associated with it like mobility, volatility, network scalability. Therefore researchers are highly focused on proposing a standardized and suitable routing protocol for highly dynamic environment of VANET. Main objective of this paper is to analyze the behavior of reactive routing protocols (AODV) and proactive routing protocols (DSDV).

2. ARCHITECTURE OF VANET C2C-CC

Recent advance in wireless technology and trends allow many number of architectures which can be implemented in highway, rural and in urban environment. One of the such architecture is proposed within C2C-CC [1]. Each vehicle will have two elements On-Board Unit and Application Unit. On-Board Unit (OBU) is responsible for communication with other vehicle or Road Side Unit (RSU) which are communicating and stationary unit beside the road whereas Application Unit (AU) has the ability to run single or many application to assist driver throughout the journey.

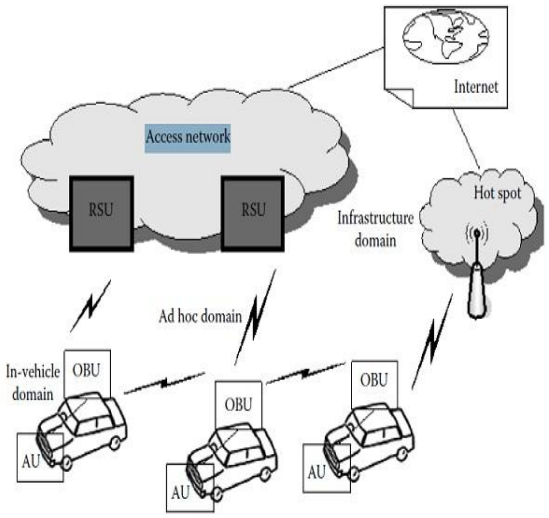

Fig. 2.1 VANET Architecture [1]

Ad-hoc network will consist of vehicles having OBU and Road Side Unit along the road. OBUs and RSUs can be considered as node of an Ad-hoc network.

3. APPLICATION OF VANET

- **Public safety applications** would increase the protection of the people in the vehicle, the vehicle itself as well as pedestrian. The systems shall save lives by reducing the chance of an accident.
- **Resource Efficiency** refers to stable traffic fluency. With the growth of industrialization, people and businesses rely more on roadways which ultimately increase the traffic congestion, since traffic congestion is becoming an increasingly severe problem. Better traffic efficiency results in less

congestion and lower fuel consumption, which will result in efficient use of resources.

- **Advanced Driver Assistance Services** provide numerous services to drivers and passengers. This makes driving more comfortable by providing access to different services such as easy toll payment without stopping, internet access while traveling

4. VANET vs MANET

Vehicular ad-hoc network is an enhanced version of mobile ad-hoc network where nodes are replaced by vehicles. Although basics of both of these ad-hoc network is same but still there exist some differences.

Properties	MANET	VANET
Node's mobility	Mobility in MANET is random.	Mobility of nodes in VANET is well defined because of roadways.
Energy Constraint	Rely on batteries for their energy therefore energy conservation is an issue here.	Energy conservation is not an issue here because nodes (vehicles) can provide continuous energy.
Network Size	Limited Network size.	Very large network can extend over the entire road network.
Connectivity	Connectivity among nodes is not an issue.	Because of highly dynamic nature results in frequent disconnected network.

Table 4.1 MANET vs VANET

5. ROUTING PROTOCOLS

Routing is a process to select an route along which data can be transferred from source to target . Several routing protocols have been implemented to accomplish route selection process. Since VANET is an enhanced version of MANET therefore routing protocols of MANET can be implemented in VANET and their results can be analyzed in VANET's mobility scenario. Classification of routing protocols of VANET can be seen below.

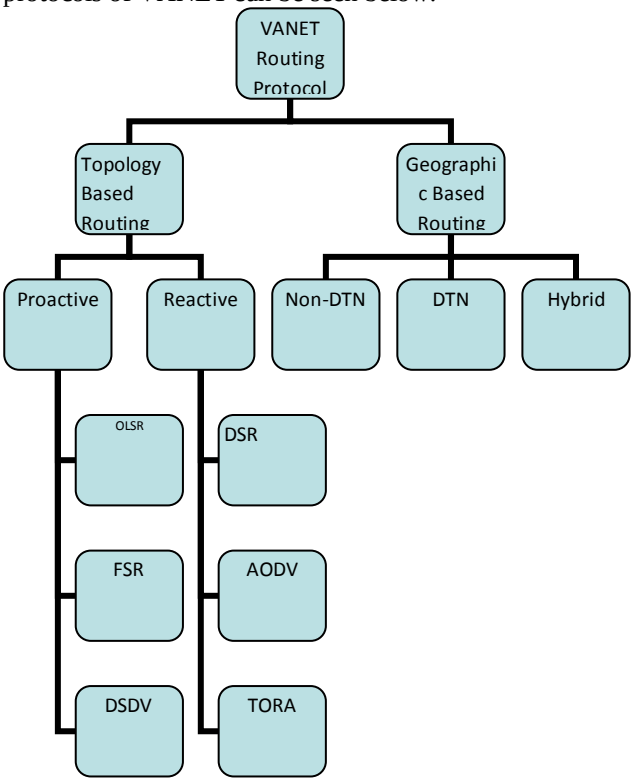

Fig 5.1 Routing Protocols

5.1 Destination Sequence Distance Vector Routing [3] It is proactive routing which means it maintain records of connected node to transmit data from one node to another. It is based on Bellman-Ford algorithm, each node in the network share route table with its neighbor node. Each route entry contain node's i.p address, last known sequence number, hop count. Each node broadcast its entries

- **Periodically** Periodic updates are broadcast by nodes after fixed period.
- **Immediately** Immediate updates are broadcast by nodes whenever there is change in its routing table.

Main advantage of DSDV is that it prevents the formation of loops in network.

5.2 Ad-Hoc on Demand Distance Vector Routing [4, 5] It is reactive routing protocol which means it establish path to destination only when node has something to send. It is capable of both unicast and multicast. For route discovery and maintenance purposes following types of control messages are defined by AODV.

- **RREQ** When node has data to send it broadcast route request message (RREQ) to its neighbors. This message is forwarded by intermediate nodes until destination is reached. RREQ packet contain information RREQ id, destination i.p address, destination sequence number, originator i.p address, originator sequence number.
- **RREP** On receiving RREQ message intermediate nodes unicast route reply message (RREP) to source if it is valid destination or it has path to destination and reverse path is constructed between source and destination. RREP packets contain information hop count, destination sequence number, destination i.p address, originator i.p address.

- **RERR** Whenever there is link failure route error message (RERR) is used. RERR contain information Unreachable Destination IP Address, Unreachable Destination Sequence Number.

6. SIMULATORS USED

Developing a VANET in practical application in too costly therefore to test and to evaluate the protocols simulators are used. Simulation of protocol is the initial step of implementation of VANET protocols. Several communications network simulator already exist to provide a platform for testing and evaluating network protocols, such as NS-2[6], OPNET [7] and Qualnet [8].Several simulation tools available such as PARAMICS [9], CORSIM [10] and VISIM [11], MOVE[12], SUMO[13], NS-2, etc which have been developed to analyze transportation scenarios at the micro and macro-scale levels. Node mobility is the most important parameter in simulating ad-hoc network. In this analysis following simulation tools have been used.

- **MOVE-(Mobility model generator for Vehicular network)[12]** is a java based tool with GUI and built on top of micro traffic simulator SUMO[13].It has the facility to generate real world mobility model for VANET simulation. It has set of GUI that makes it easier to create a real world simulation scenario. Output obtained by MOVE is a trace file which can be further used by NS-2 .

- **NS2 (Network Simulator)** is an object oriented, discrete event driven network simulator developed at UC Berkeley written in C++ and OTCL . NS is very popular simulation tool for routing and multicast protocol and is generally used in ad-hoc networking research. C++ and Object-oriented Tool Command Language (OTcl) are the two key language of NS-2. C++ is used as backend where as OTcl has been used as frontend.

- **SUMO (Simulation of Urban Mobility)[13]** It is microscopic road traffic simulation tool. It is script based tool. It help user to create a road topology with vehicles movement according to his requirement

7. SIMULATION DESIGN AND PERFORMANCE METRICS

All tests have been performed on different scenarios having 10, 20, 40, 80 nodes with 5, 10, 20, 40 connections respectively. With the help of simulators MOVE and SUMO a grid view map has been created which is shown in fig.7.1 with the total area 652 m x 752 m.

Channel type	Wireless
Network Interface type	Physical wireless
Routing protocol	AODV (NS2 default) and DSDV(NS-2 default)
Queue Length	50 packets
Number of nodes in topography	10, 20, 40, 80
Time of Simulation end	400 seconds
Traffic Type	TCP
Speed	40m/s
MAC protocol	IEEE 802.11
Packet Size	512 Bytes

Table 7.1 Simulation Configuration

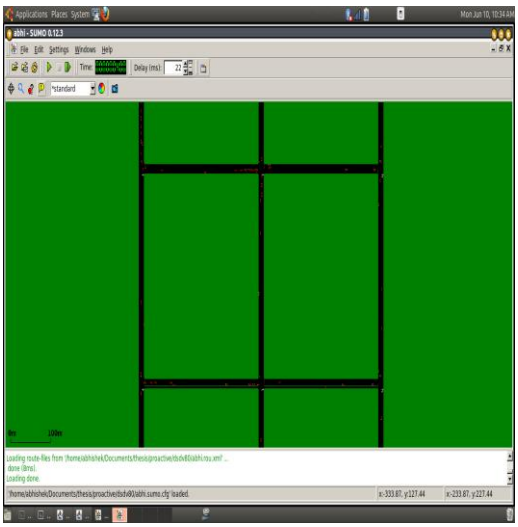

Fig.7.1 Grid view map used in the simulation

7.1 Performance Metric

Following parameters has been used to analyze the behavior of routing protocols

- **Throughput** – It is defined as amount of data per unit time that has been delivered to one node from another. It is calculated in Kbps.
- **End to End delay**- It is defined as the average time taken by data packet to propagate from source to destination across network. It include various delays introduced because of route discovery, queuing, propagation and transfer time.
- **Packet Delivery Fraction**- It is defined as the ratio of the data packets received by the destinations to those generated by the sources. With the help of PDF one can understand how well a protocol can transfer packet from source to destination.

8. SIMULATION RESULTS

This section is used to describe result of comparison between AODV and DSDV using packet delivery faction, throughput, end-to-end delay. Graphs are used to represent the result obtained by simulation. Result obtained is discussed as follows.

- **Throughput** – Result obtained is given in fig.8.1 . As we can observe from the graph that throughput of AODV is better than DSDV because DSDV broadcast entire routing table after fixed interval of time which introduce extra overhead which affect its throughput.

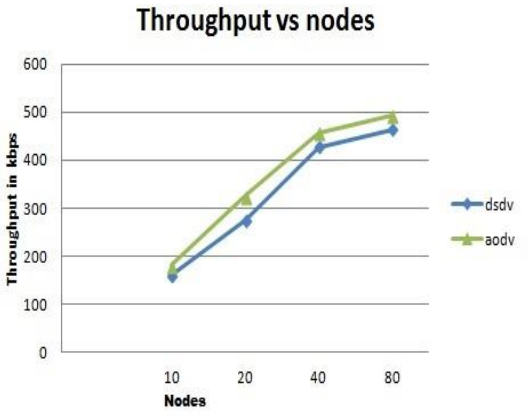

Fig 8.1 Graph between Throughput and Nodes

- **End to End Delay -** Result obtained is given in fig.8.2 .We can clearly observe from the graph that end to end delay introduced in AODV is more as compared to DSDV. Since AODV is reactive protocol and it establish routes only when source has something to send which introduce an extra delay in AODV.
- **Packet Delivery Fraction -** Result obtained is given in fig.8.3 .It is clear from the graph that packet delivery fraction in AODV is better than DSDV because of great control overhead lots of bandwidth is consumed for transmission of control messages and thus data packet will lost. It is also observed that up to 20 nodes packet delivery fraction of both protocols increases but because of more nodes and more connection more packets have been introduced in network there is decrease in packet delivery fraction for 40 and 80 nodes .

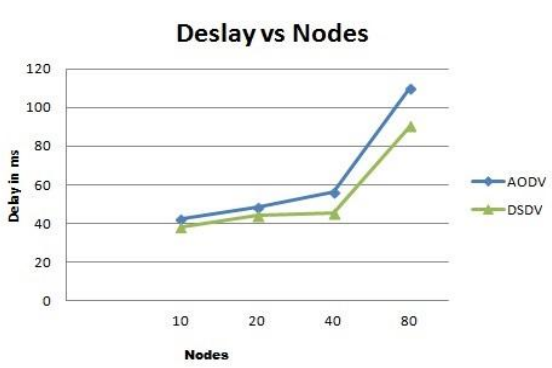

Fig. 8.2 Graph between Delay and Nodes

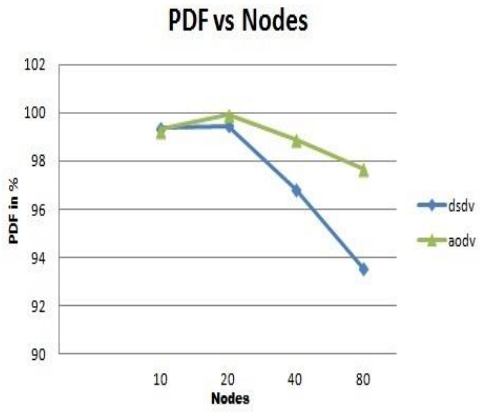

Fig 8.3 Graph between PDF and Nodes

9. CONCLUSION

In this paper routing behavior of AODV and DSDV in grid view map has been analyzed using simulators ns2.35, MOVE and SUMO. Map designed using MOVE and SUMO represents a scenario of any urban area. It is observed that one protocol is

better than another under one performance and at the same time it inferior to another under another performance metric. It has been clearly observed that AODV is better than DSDV under the metrics throughput and packet delivery fraction while DSDV is better than AODV under the metric end to end delay. It can be clearly concluded by the result obtained that both of these protocols are not very much suitable for VANET.

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