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Comparison of the AODV, DSR and DSDV routing protocols in Urban/Rural Areas using VANET Route Traffic Analysis

PRAMOD MUTALIK and Dr.VENAKANGOUDA C PATIL

Assistant Professor, Department of Electronics & Communication, Ballari Institute of Technology and Management Bellary, India.

Professor and Principal, Department of Electronics & Communication, Ballari Institute of Technology and Management Bellary, India.

***Abstract*— Vehicular Ad Hoc Network (VANET) is an emerging new technology integrating ad hoc network, wireless LAN (WLAN) and cellular technology to achieve intelligent inter-vehicle communications and improve road traffic safety and efficiency. VANETs are distinguished from other kinds of ad hoc networks by their hybrid network architectures, node movement characteristics, and new application scenarios. Therefore, VANETs impose many unique networking research challenges, and the design of an efficient routing protocol for VANETs is very crucial. Nowadays, Intelligent Transportation System (ITS) has a major impact on improving the quality and efficiency of the transportation system. When we talk about luxury and secure implementation of VANET, vehicle will query data from any other vehicle through multi hop infrastructure. While data is moving in VANET it will suffers from recurrent interruptions due to frequent mobility and sporadically linked network system. In this paper, studies and comparison of the following three routing protocols AODV, DSR and DSDV have been done. The analysis has been measured and evaluated in both urban and rural environments. Contrary to the pessimistic conclusion of previous works, by incorporating the classification accuracy is improved in the routing algorithms used. The proposed system analyzes the vehicles density, data drop, and throughput and end-to-end delay.**

Keywords— VANET, Vehicular communication, ITS, AODV, DSR, DSDV Protocol.

I. INTRODUCTION

Vehicular Ad Hoc Networks (VANETs) are emerging new technology to integrate the capabilities of new generation wireless networks to vehicles. The idea is to provide ubiquitous connectivity while on the road to mobile users, who are otherwise connected to the outside world through other networks at home or at the work place, and efficient vehicle-to vehicle communications that enable the Intelligent Transportation Systems. Therefore, vehicular ad hoc networks are also called Inter-vehicle Communications or Vehicle-to-Vehicle communications. ITS is the major application of VANETs. ITS includes a variety of applications such as co-operative traffic monitoring, control of traffic flows, blind crossing, prevention of collisions, nearby information services, and real-time detour routes computation. Another important application for VANETs is providing Internet connectivity to vehicular nodes while on the move, so the users can download music, send emails, or play back-seat passenger games. As the number of vehicles on the road increased over the years, the need for safety on our roads cannot be over emphasized. VANET is a cluster of transporters equipped to communicate with each other either in an ad-hoc way (without any existing infrastructure) or with a nearby Road Side Unit (RSU). VANET has become an increasingly interesting focus of researchers and the automobile industry because it can enhance safety on the roadways by allowing vehicles to communicate with one another to prevent unwanted situations, Thus enhancing comfort and safety of road users.

Figure 1. Communication architecture of VANET.

Fig. 1 shows the architecture of VANET in which different components are shown. This is a generic architecture in which data is transferred among different On-Board Units (OBU). Intelligent Transportation Systems (ITS) is a wide-ranging technology system applicable to transportation to make system safer, more effective, and more reliable and more environment friendly, without altering the existing infrastructure. Technologies ranges include sensor network, control technologies, communications system, computer informatics, transportation, engineering, telecommunications, computer science, finance, electronic commerce and automobile manufacturing.

Intelligent Transportation Systems (ITS) have been developed to improve the safety, security and efficacy of the transportation systems. The field of Inter Vehicular Communications (IVC), including both Vehicle-to-Vehicle communication (V2V) and Vehicle-to-Roadside communication (V2R), also known as VANET, is recognize as an important component of ITS in various national plans.

Figure 2. Inter Vehicular Communications (IVC).

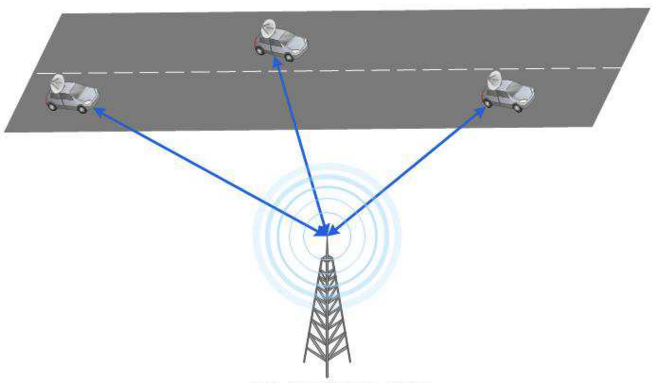

Figure 3. Vehicle to Infrastructure Communication (V2I).

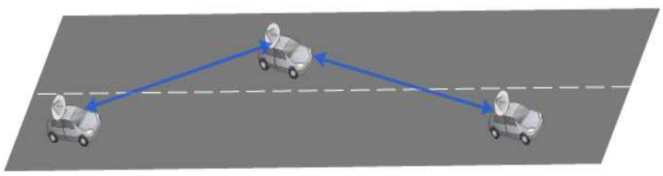

Figure 4. Vehicle to Vehicle Communication (V2V).

Vehicular Ad-Hoc Network (VANET) communication has become a progressively important research topic in the area of wireless networking as well as the automotive industries. The goal of VANET research is to develop a vehicular communication system to enable cost-effective and fastest communication of data for the benefit of passengers' safety and comfort.

A vehicular ad hoc network (VANET) is an emerging research area for the communications industry and academician. Researchers proposed an entirely new wireless networking concept, i.e., vehicular ad hoc network which can increase passenger safety and reduces vehicle collisions on the road. Wireless communication among moving vehicles is unique and innovative research era in the academics and in the corporate sector, driven by the vision to communicate information among vehicles to ensure the safety and comfort of the users.

Nowadays, automobile industry have equipped their new vehicles with Global Positioning Systems (GPS), digital maps and even wireless interfaces, e.g., Honda-ASV3.The network architecture of VANET can be classified into three categories: Cellular network/WLAN, ad hoc network, and hybrid network.

This paper summarizes the impact of topology-based routing protocols in urban and rural area scenarios.

II. VANET ROUTING PROTOCOLS

In VANET, the routing protocols are classified into five major categories:

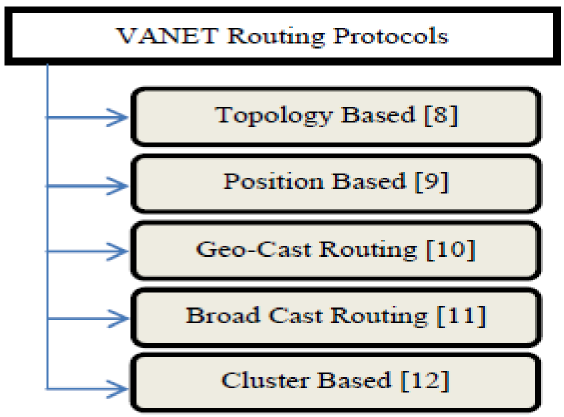

Figure 5. VANET routing protocols Categories

VANETs consist of vehicles which have to follow the traffic rules of movement unlike MANETs in which nodes move randomly without any movement restrictions. VANETs have very flexible and complex topology due to multiple routes on which drivers move at different speeds, with different driving behavior, whereas in MANET's topology changes are less frequent. Due to these distinguished differences between MANETs and VANETs, MANETs routing protocols have to be studied first and verified for their compatibility in VANET environments. The routing protocols, which are selected for this study, belongs to a special branch of MANET routing protocols namely Topology Based Routing Protocols. The main reason for such a selection is the dynamic topology aspect of VANETs, which has a straight implication on routing protocol analysis.

A. *Topology Based Routing Protocols*

In this paper, we have considered proactive and reactive protocols. Topology based routing protocols use link's information, which exists in the network and use as packet forwarding.

These protocols can be categorized into:

- Proactive (Table-Driven) routing protocols.
- Reactive (On-Demand) routing protocols.
- Hybrid routing protocols.

B. *Proactive-Routing Protocols*

Proactive routing protocol is also named as "table-driven" routing protocol. In proactive routing protocol, nodes in a mobile ad-hoc network incessantly assess routes to all accessible nodes and try to uphold reliable, up-to-the-minute routing information in their routing tables. FSLS, DSDV, OLSR etc. are examples of proactive-routing protocols.

1) *Destination Sequenced Distance Vector (DSDV)*

It is Table Driven routing protocol which is used in VANET; is grounded on classical Bellman-Ford algorithm. Primarily every vehicle broadcasts its own route information tables to its neighbor vehicles. The neighbor vehicles keep up-to-date routing table by two type of packets- Full Dump Packet and Incremental Packet. Full Dump Packet comprises information about every contributing vehicle in the VANET. These packets are communicated intermittently after a long time intermission. Incremental Packet covers latest change in vehicle position since last Full Dump Packet. Routes are nominated with the up-to-date entry in the table. DSDV is better option for networks where location of nodes is less changeable.

C. *Reactive Routing Protocols*

Reactive routing protocols for mobile ad hoc networks are similarly known as "on-demand" routing protocols. In a reactive destination node but no route is accessible, it initiates a route detection process. It is initiated with RREQ (route request) packet, response is with route reply (RREP) and while link is not available it is received route error (RERR) packet. Reactive routing protocols has less overhead, a unique feature, while reactive routing protocols scalable than proactive routing protocols. But while using reactive routing protocols, source nodes may undergo routing protocol, routing paths are look for only while it is desirable. Henceforth these protocols are not appropriate for real–time applications. The Dynamic Source Routing (DSR) and Ad hoc On-demand Distance Vector routing (AODV) are examples for reactive routing protocols.

1) *Ad Hoc on-Demand Distance Vector Routing (AODV)*

It is a Source Initiated on Demand routing protocols used in VANET. In this protocol, every vehicle retains its route information of every vehicle. Sequence number is used to accept an acknowledgment of update for table entry. If a table entry is not used within a certain time limit, it will be erased from table and if there is any route is disconnected from vehicle to another vehicle, route error (RERR) packet is generated so that vehicle route is efficiently updated in its routing table.

2) *Dynamic Source Routing (DSR)*

It is Source Initiated on Demand routing protocol used in VANET and is grounded on link state routing algorithm. When a vehicle needs to transfer data to another vehicle, first it initiates route discoveries request up to that vehicle. For route finding, source vehicle recruits a route request (RREQ) packet in the network and other nodes forward the RREQ by changing their name as sender. Lastly when RREQ packet spreads to the destination vehicle or to a vehicle having path to the destination vehicle, a route reply (RREP) packet is unicasted to the sender node. If the reply packet is not received, the source vehicle resumes violent discovery of route up to the destination vehicle.

III. EXPERIMENTAL MODEL AND SCENARIOS

In the vehicular networks, basically, two different types of simulator are required; first, is network simulators, and second, is traffic simulator. But, in proposed solution, a hybrid simulator is used which offers a mixing services of both network and traffic simulator. The hybrid simulator EstiNet 7.0 is the commercial version of NCTUns network simulator and emulator. EstiNet 7.0 is a world-renowned tool and has been used by more than 20,000 listed users from 144 countries all over the world. EstiNet 7.0 is latest version and whose central technology is based on the novel kernel re-entering methodology invented by Prof. S.Y. Wang [10]. The various features of VANET supported by EstiNet 7.0 make it a clear choice for proposed research work.

A. Simulation Model and Parameters

TABLE I. GENERIC SIMULATION PARAMETERS

Routing Protocols in both scenarios	AODV, DSR and DSDV
Channel type	Wireless channel
MAC protocol	802.11p
Mobility model	Random Way Point(RWP)
Theoretical Channel Model	Two Ray Ground

B. Urban Area Scenario

Fig. 6 shows the urban area grid scenario where 80 vehicles devices identified as On-Board Units (OBUs) communicate with each other as well as with RSU (Road Side Unit) .Vehicles show the network behavior as the OBUs move within the network to analyze the performance of each protocol. While assessing the performance of a given scenario in the Vehicle-to-Vehicle communication (V2V) and Vehicle-to-Roadside communication (V2R) vehicles move within network and establish VANET. In this mobility model we used Random waypoint. By using this mobility model, vehicles are free to move to reach at random destination. Movement of the vehicles is calculated by the algorithm.

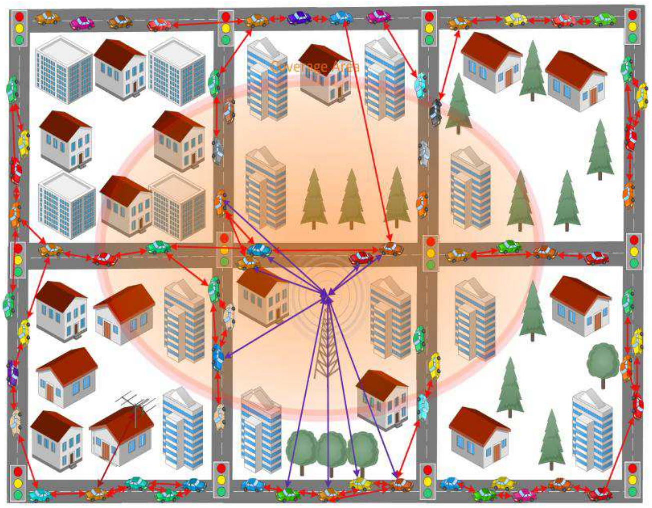

Figure 6. Urban Area Grid Scenario.

Table II describes the simulation parameter used in the urban area scenario.

TABLE II. URBAN AREA SIMULATION PARAMETERS

No. of Vehicles	80
Simulation area	2X2Km
Simulatio Time	90 minutes
Vehicle Speed	10 m/sec
Channel bandwidth	6 Mbps
Transport protocol	UDP
Transmitted power	28.8dbm

C. Rural Area Scenario

Figure 7. Rural Area Scenario.

Fig. 7 shows rural area grid scenario where 15 On-Board Units (OBUs) communicate with each other as well as with RSU (Road Side Unit) .Vehicles show the network behavior as the OBUs move within the network to analyze the performance of each protocol.

Table III describes the simulation parameter used in the rural area scenario.

TABLE III. URBAN AREA SIMULATION PARAMETERS

No. of Vehicles	80
Simulation area	2X2Km
Simulatio Time	50 minutes
Vehicle Speed	10 m/sec to 18 m/sec
Channel bandwidth	6 Mbps
Transport protocol	UDP
Transmitted power	28.8dbm

IV. PERFORMANCE RESULTS OF AODV, DSR, DSDV

The following graph shows the performance of the routing protocol using different metric considered above. The x axis represents the time in seconds and y axis represents the metric considered.

A. *Throughput*

From Fig. 8, it can be realized that in urban area scenario throughput with DSR protocol is better than with AODV and DSDV with throughput peak reaching up to 300 kB/s. It is also observed that, when speed is increased and more vehicles connected to the RSU than AODV performance suddenly degrades from about 270 KB/s to 40 KB/s, while DSDV performance slightly decrease remains moderately the same.

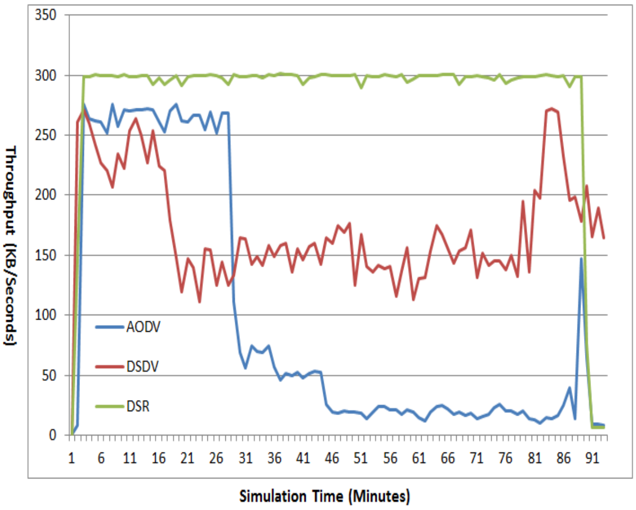

Figure 8. Throughput Performance in Urban Scenario.

Fig. 9 shows the Throughput in rural scenario. Clear implication from graph DSR Throughput is uppermost. AODV Throughput remains in between other two and DSDV Throughput is lowest among all three.

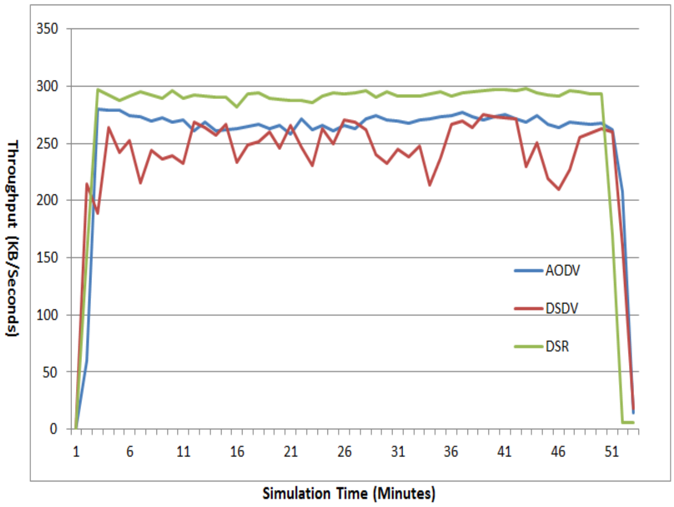

Figure 9. Throughput in Rural Scenario.

B. *Packet Dropped*

The packet drop performance of DSR protocol is much better than AODV and DSDV in urban and rural scenarios, as is seen from Fig. 10. About 10 to 20 packets dropped in urban area while less than 50 packets drop in rural scenario while this drop of packets better as time passes for the DSR protocol. As the speed is increased the packet drop rate for AODV protocol increases from 200 to 1100 drop packets in urban area whereas in rural area packet drop for AODV remain between 100 to 140 packets. In terms of dropped packets for DSDV's performance is the worst in both scenarios. The performance degrades with the increase in the number of nodes and speed. The performance degrades with the increase in the number of nodes and speed.

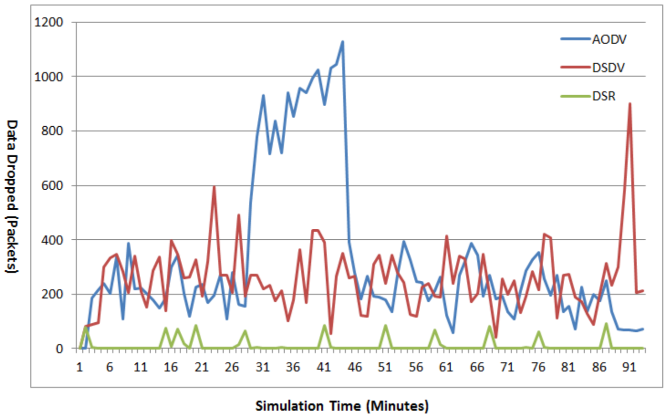

Figure 10. Packets Dropped in Urban Scenario.

Fig. 11 shows the drop packet performance of DSR protocol is better than for both AODV and DSDV in urban scenario. As the number of vehicles increased, data dropped ratio of DSDV suddenly increased from 29 to 480 packets that much worst in entire simulation.

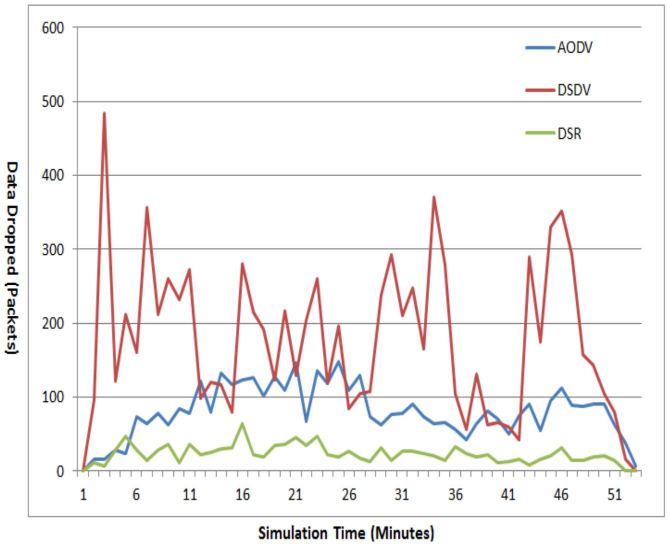

Figure 11. Dropped Packets in rural Scenario.

V. CONCLUSION

In this research, analysis the simulations are performed to compare the performance of On-Demand (DSR and AODV) and Table-Driven (DSDV) routing protocols by using the two different scenarios. Also measured the metrics like data collide, data dropped, etc. The results presented in Table 5 for different traffic scenario and for three VANET routing protocols, performance of DSR has been found to be better than that of AODV and DSDV. From the parameter values characterizing the two traffic scenarios, DSR is found suitable for both rural and urban traffics scenarios. Thus it can be concluded that DSR outperforms from other routing protocols AODV and DSDV in both urban and rural area scenarios.

TABLE IV. COMPARISION OF ROUTING PROTCOLS

Parameters	Scenario	Routing Protocols		
		AODV	DSDV	DSR
Throughput	Urban	L	M	H
Throughput	Rural	M	L	H
Data Dropped	Urban	H	M	L
Data Dropped	Rural	M	H	L
Data Collide	Urban	H	M	L
Data Collide	Rural	M	H	L

H = High, L=Low, M = Medium

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