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Traffic Analysis in Rural/Urban Area Using VANET Routing Protocols

Arif Nawaz* and Ahsan Raza Sattar

Department of Computer Science, University of Agriculture, Faisalabad, Pakistan

Abstract

Mobile ad hoc network has a subtype which is known as vehicular ad hoc network. It is useful for the communication among the vehicles and road side infrastructure. These days for the quality and deficiency of transportation system intelligent transportation system ITS is playing a great role. Whenever we talk about the implementation of a secure and luxury vehicular ad hoc network, vehicle will have to query data from any other vehicle via multihop infrastructure. When data moves in vehicular ad hoc network it has to face many interruptions due to lot of mobility and linked networks. In this paper following protocols are studied and comparison is performed on AODV, DSDV and DSR. The research is performed on both rural and urban areas. Analysis id performed on the basis of data drop, vehicles density, throughput and end to end delay.it is analyzed from the obtained results that in form of low packet drop and high throughput DSR give better results as compared to AODV and DSDV in rural areas and AODV gives good performance in comparison to DSR in environment of low density.

Keywords: Intelligent transportation system; Ad Hoc on demand distance vector; Dynamic source routing

Introduction

Since last two decades wireless technology is growing so fast. For different applications research and new developments have played a great role for researchers to find cost effective and unique solutions. Wi-Fi, WiMAX, visible light communication, sensor networks, ad ho networks are some examples of wireless network technologies. Which are being used in security, engineering, network monitoring, medical, remote sensing, education, telecommunication, location tracking and in tracing systems [1,2].

Figure 1 depicts vehicular ad hoc networks architecture. In this architecture various components are shown. This is a general diagram in which among different on board units OBU data is transferred. A very latest system is being used which is transportation system to make it more effective, reliable, safer and more environment friendly [3]. This system is known as intelligent transportation system ITS. And this system is being used without effecting or altering the existing system. This system is also being used in automobile manufacturing, ecommerce, computer science, engineering, finance, telecommunications, computer informatics, transportation and in sensor networks. For the improvement of security, safety, efficiency of transportation system Intelligent Transportation system has been developed. Vehicular ad hoc networks include both vehicle to vehicle or vehicle to road side communication. Both of these communication types are considered as the most important component of intelligent transportation system (Figure 2).

Both in automotive and wireless technologies vehicular ad hoc network communication has become an important topic. Goal of VANETs research is to make cost effective and fastest communication of data for the passengers comfort and safety.

VANET is an interesting research field for the network industry and researchers. Researchers give a new networking concept i.e. VANET known as vehicular ad hoc network that can improve passengers comfort, safety and guarantee less vehicles collision.

In academics and in corporate sector vehicular ad hoc network is an emerging area for research this idea is driven by wireless networks and communication among the moving vehicles and for giving them safe and secure journey [4].

Now all the new vehicles are equipped with global positioning system by automobile industry. In these vehicles digital maps and wireless interfaces are also equipped. Vehicular ad ho network is categorized into 3 types, ad hoc network, cellular network and hybrid network [5]. In this research paper topology based routing protocols in urban and rural areas are elaborated.in section 2 problem statement,

Figure 1: Communication architecture of VANET.

***Corresponding author:** Nawaz A, Department of Computer Science, University of Agriculture, Faisalabad, Pakistan, Tel: +92 41 9200161; E-mail: Arifnawaz72@yahoo.com

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Figure 2: Inter Vehicular communications (IVC).

in section 3 wireless access methods and in 4 routing protocols in in VANETs are discussed. While in section 5 experimental and model scenarios are described. And in 6 and 7 results and conclusions are discussed.

Problem statement

As the wireless technology is improving and intensive research is being conducted on VANETs. It is needed that vehicles should be equipped with GPS system. So that it should might help in sharing of data when vehicular ad hoc network is created. So that data of network configuration and sharing path should be established before.

Difficulties and challenges which are faced in ad hoc networks are energy utilization, security, band width limitations, network performance and scalability. In this paper different parameters are used like data drop, vehicular density end to end delay throughput to check the performance of the network.

Wireless access standards for VANET technology

WAVE is usually considered as the developing standard for the wireless mobile communication. Dedicated short range is also known as WAVE or wireless access vehicular ad hoc networks. Wireless access vehicular ad hoc network or DSRC (dedicated short range communication) supports vehicle to vehicle and vehicle to infrastructure communication for intelligent transportation system. DSRC/WAVE play a great role in wireless networks by providing high data rate, high mobility communication and low delay in wider areas [6].

Dedicated short range communication

Dedicated short range communication is a well-known facility that range from short to medium to keep vehicle to vehicle communication. DSRC is useful where small separated zones are required for communication with less delay, fast data transfer rate. Operations like ad hoc modes with distributed multi hop networking and single hop network with centralized mode are performed by DSRC [7].

WAVE system/ IEEE 802.11P

For network users IEEE has released standards. IEEE P1609.1, P1609.2, P1609.4 for experimental use and fourth P1609.4 is yet under development phase. For wireless access vehicular envoirment P1609.1 work as resource manager. It explains the interfaces and services of WAVE resource manager application and format of message data. It provides instant access for various applications to other network designers [8].

The WAVE stack uses IEEE802.11P for medium access control layer protocol. For link sharing and usage one control channel to set up transmission channels, WAVE uses carrier sense multiple access protocol or collision avoidance CSMA/CA as a basic medium access protocol.

VANET routing protocols

In vehicular ad hoc network following are major routing protocols. Topology based, position based, Geo cast routing, broad cast routing and cluster based routing.

Unlike MANETs, VANETs node move randomly without movement restrictions. Due to multiple routes VANETs have very complex and flexible topology in which drivers move [9].

In this research paper reactive and proactive protocols are discussed, routing protocols which use links information which is found in network and use that information in packet forwarding are topology based routing protocols. Topology based routing protocols are categorized into:

- Proactive routing protocols
- Reactive routing protocols
- Hybrid routing protocols

Proactive routing protocols

Table driven routing protocols are also called proactive routing protocols, in table driven routing protocols nodes in mobile ad hoc networks access routes of all accessible nodes that try to uphold reliable routing information in their routing tables. DSDV, FSLS and OLSR are also types of proactive or table driven routing protocols [10].

DSDV

DSDV is table driven routing protocol that is used in vehicular ad hoc network. It is based on Bellman Ford algorithm. Basically each vehicle share its own path information tables to their neighbor vehicles. Those neighbor vehicles use incremental packet and full dump packet for keeping their routing table up to date. Full dump packet contains information of every participating vehicle in vehicular ad hoc networks. While incremental packet contain latest updation in vehicle position since of last full dump packet. Paths are named with up to date entry in the table. Where the location of nodes is less changeable DSDV is good option for those networks [11].

Reactive routing protocols

Reactive routing protocols also known as on demand routing protocols. In reactive routing protocol no destination node is accessible in this a route detection process is initiated. For initiation a route request packet RREQ is used and route reply comes with RREP. When link is not accessible route error RERR packet is received. Less overhead is found in reactive routing protocols. Ad hoc on demand distance vector and dynamic source routing protocols are types of reactive routing protocols [12].

Ad hoc on demand distance vector routing protocols AODV

In this every vehicle contains route information of every vehicle. To accept acknowledgment for the updation of table entry sequence number is used. If table value is not used in specific time that will be erased and if route is disconnected between vehicles to another vehicle RERR packet is forwarded so that route of vehicle could might be updated in routing table efficiently.

Dynamic source routing DSR

In VANET it is used as source initiated on demand routing protocol that is based on link state routing protocol. When a vehicle wants to transfer data to other vehicle it first send route discovery request to that vehicle. For route discovery sending vehicle recruits a route request packet in the network and the other vehicles forward route request by updating their name as sender. Previously when route request message spreads to the destination vehicle or to a node having route to the destination vehicle, a route reply message is unicasted to the sender node. If the route reply packet is not received the sender node resumes discovery of route up to the destination node [13].

Experimental Model and Scenarios

In vehicular ad hoc networks two types of simulators are used, first network simulator and second network simulator. But in this research a hybrid simulator is used, named as ESTINET 7.0 which gives facilities of both traffic simulator and network simulator. It is very famous tool. Which is used by more than 20000 users from all over the word (Table 1). ESTINET technology is a latest technology which is based on novel kernel invented by Wang and Sodini [14].

Urban area scenario

In Figure 3 it is shown that in grid area scenario 80 vehicles are identified as on board units sharing data with each other and with Road side units RSU. Nodes are showing behavior as on board units move in the network to check the performance of every protocol. During the assessment of vehicles performance vehicles to road side communication and vehicles to vehicle communication vehicles makes vehicular ad hoc network. In mobility model of vehicles random way point is used (Table 2). In this model nodes or vehicles are free to move and find their destination. Calculation of vehicles movement is performed by algorithm [15].

Rural area scenario

In Figure 4 rural area grid scenario is shown, where 15 on board units share data among each other and with also road side units. Vehicles show vehicular ad hoc network behavior as the vehicles move to check the protocols performance (Table 3).

Performance results of AODV, DSR and DSDV

Performance of routing protocols is shown in graphs by using different parameters explained above. Y axis shows metric considered and x axis shows time used in seconds.

Throughput: In Figure 5, it can be observed that in the scenario of urban area throughput using dynamic source routing protocol is good than DSDV and AODV. It is also realized that when speed is increased and many vehicles connected to road side units than ad hoc on demand distance vector performance decreases. And performance of DSDV also decreases.

Figure 6 shows the throughput in rural area scenario. Form graph it is clear that DSR throughput is higher than all. DSDV throughput is lowest of all others, while AODV throughput is in middle of both.

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

Table 1: Simulation model and parameters.

Packet drop: Dynamic source routing protocol has much better performance than DSDV and AODV with respect to packet drop in rural and urban scenarios. It can be seen in Figure 7. Near about 10 to 20 packets dropped in urban area and less than 50 packets drop in rural area. And as the time passes this ratio for DSR decreases. Packet drop rate for AODV increases as the speed increases in rural area. And packet drop rate for AODV remain among 100 to 140 packets. DSDV's

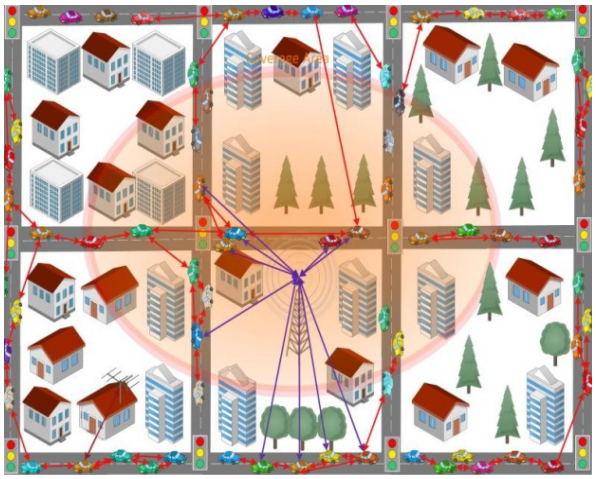

Figure 3: Urban area grid scenario.

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

Table 2: Describes the simulation parameter used in the urban area scenario.

Figure 4: Rural area scenario.

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

Table 3: The parameters performance in rural area scenario.

performance remains worst in both scenarios. As the number of nodes and speed increases performance decreases.

Dynamic source routing protocol performance is better with respect of packet dropped than AODV and DSDV in urban area [16]. Ratio of data drop in DSDV increases as the number of vehicles increases, ratio of drop increases from 29 to 480 packets which is worst in the whole simulation performed.it is shown in Figure 8.

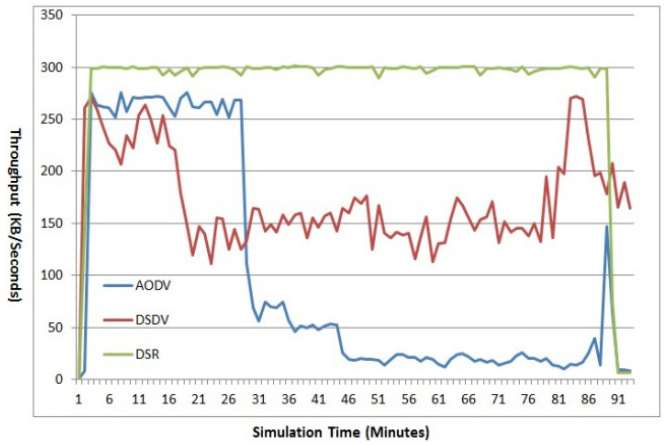

Figure 5: Throughput performance in urban scenario.

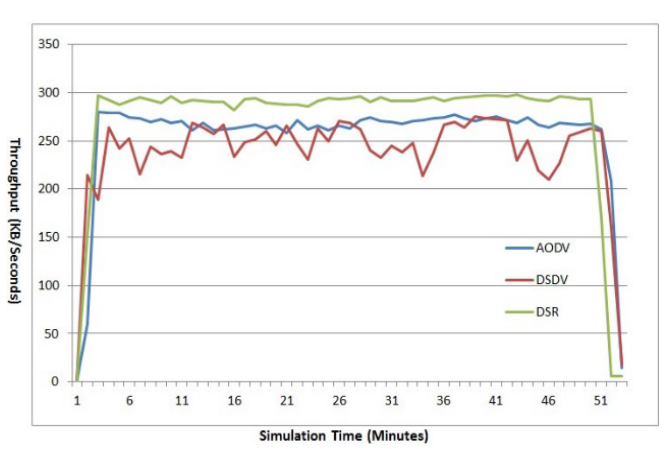

Figure 6: Throughput in rural scenario.

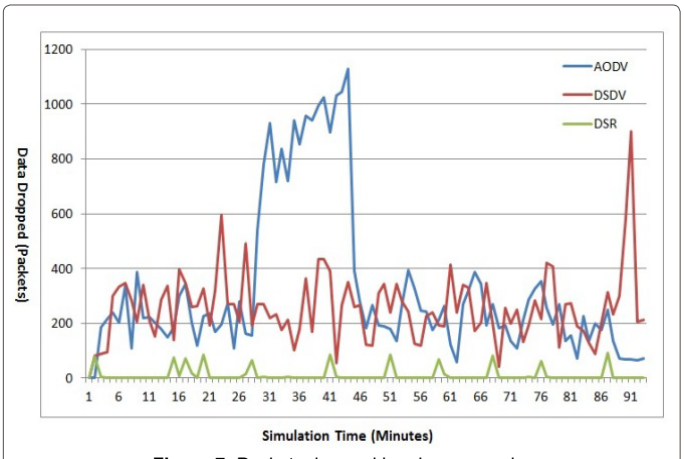

Figure 7: Packets dropped in urban scenario.

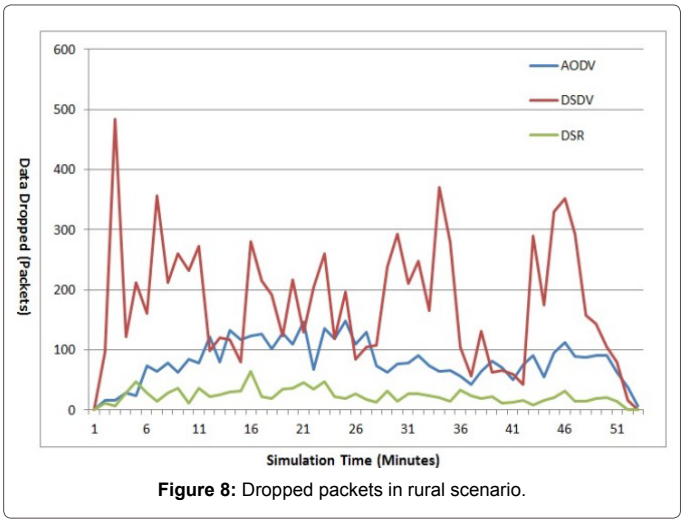

Figure 8: Dropped packets in rural scenario.

Conclusion

Under microscopic mobility model characteristics of reactive routing protocols and proactive routing protocols have been studied and their comparisons have been made. The study shows important characteristics of these protocols when they are used in vehicular ad hoc networks (VANET).

Obtained results show that performance of reactive protocol is good because path discovery mechanism, maintenance of route and minimizing the periodic broadcasting is found in approximately all the reactive routing protocols. From results it is analyzed that in DSDV end to end delay is minimum, which is the main achievement and requirement in all the real time systems. Minimum end to end delay is due to the characteristic of table driven approach. But due to this another problem in network is generated known as the overhead problem.

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