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Modified AODV with double ended queue(dqAODV) with reduced overhead

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Abstract

Vehicular ad hoc network (VANET) is the new specialization of mobile ad hoc network (MANET). It provides intelligent Transport System i.e., wireless communication among vehicles and vehicle to roadside equipments. This both types of communication road network classified into two types 1) vehicle to vehicle communication, 2) vehicle to infrastructure communication. In current scenario traffic condition VANET technique is very useful technique for achieving safe and secure and effortless transport system. This communication system, there are different types of routing protocols are introduced. But compared to all of these routing protocol does not work efficiently in VANET. Where as we found AODV is fitted best among all well known proposed routing protocols. But AODV has several drawbacks with rebroadcasting on link failure as well as increasing overhead In this paper, we proposed a modified AODV routing protocol with the help of partial re-broadcasting of intermediately introduction into the RREQ header. It is based on packet delivery overhead. It shows a comparable overhead reduction information of packet transmission compare to original AODV and our proposal of dequeAODV(dqAODV). Hence our proposal is new approach to rebuild lost path of source to destination is works and a comparable performance routing algorithm to original AODV.

Keywords: VANET, broadcast, dqueue, AODV, NCTUns-6.0,

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1. INTRODUCTION

For VANET the routing protocols works on ad-hoc basis and infrastructure basis in the network [Fig.1].Where the ad-hoc network is highly unstable as vehicle's speed and lane change factors.

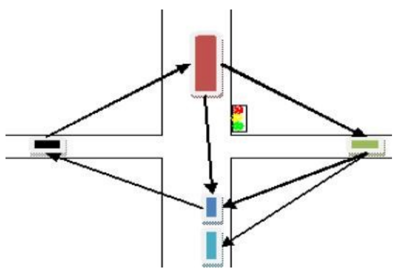

Fig.1. Ad-hoc VANET[1]

1.1 Ad-hoc Routing protocols

Ad-hoc routing protocol fist setup the path next exchange information with packets and take decision of runtime alternatives paths [1].

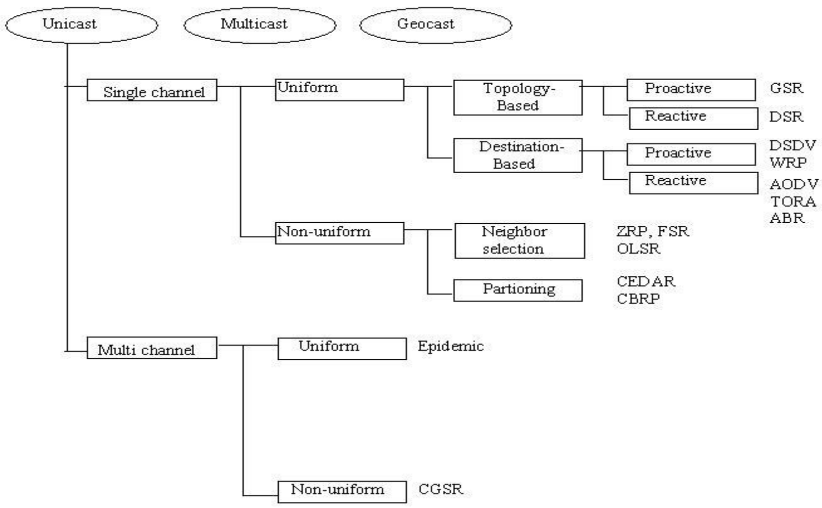

Fig.2. Classification of Ad-hoc Routing Protocols [1]

The topology based routing is classified [Fig2] in to three ways

1. Proactive (table-driven) routing protocols.
2. Reactive (on-demand) routing protocols.
3. Hybrid routing protocols (for both type).

1.1.2 Proactive Routing

Proactive routing protocols are based on shortest path first algorithms [1]. It maintains and update routing information's on routing in between all nodes of a supplied network at all times, even if the paths are not currently being used. Even if some paths are never used but updates for those paths are constantly broadcasted among nodes [1]. Route updates are periodically performed regardless of network payload, bandwidth constraints.

1.1.3 Reactive Routing

On demand or reactive routing protocols were planned to overcome the overhead problem, which was created by proactive routing protocols. Maintaining only those routes that are currently live and active [1]. These protocols implement route determination on a demand basis or need basis and maintain only the routes that are currently in use. Therefore it reducing the burden and overhead on the network when only a subset of available routes is in active at any point of time [6].

AODV maintains and uses an efficient method of routing, which reduces network burden by broadcasting route discovery packet mechanism and by runtime updating routing information at each adjacent node. Route discovery in AODV can be perform by sending RREQ (Route Request) from a node when it needs a route to send the data to a particular destination. After sending RREQ, a node waits for the RREP (Route Reply) and if it does not receive any RREP within time threshold.

The node members of contracted ad-hoc network when out of the range of the existing ad-hoc network, it may fails to progress. Hence, we need some other helping equipments (road side equipment) to help those node (Vehicle) to progress. But, irrespective of that, if we taken the existing neighbor Ad-hoc network, that can help to restart the communication with that isolate node(Vehicle),which is more economic, as we do not need any extra equipment or extra data communication.

2. BACKGROUND

Wireless technologies [2] are extended to ad hoc networks like Mobile Ad Hoc Network (MANET) and Vehicular Ad Hoc Network (VANET) [1]-[2]. Ad hoc networks are one type of network that offers communications within a certain range of areas; even connect to wide areas via basic mobile network and Internet. One of the authors has already published his useful and important findings of various routing protocols [5], mainly many variants AODV applicable in MANET. This study is the modest approach towards the justification for application of AODV routing protocol of MANET in Vehicular Transmission [3]-[4].

Thus total connectivity in a VANET is assured. VANETs are also known under different name like Dedicated Short Range Communications (DSRC), Inter Vehicle Communications (IVC), etc. Number of projects have been launched for VANET, e.g., FleaNet in USA, FleetNet in Germany, ITS in Japan, etc. [1],[5].

The motivation of a VANET project is to create a new algorithm or protocol or modify the existing one for use in vehicular environment. Thus VANET helps the drivers of vehicles to communicate the information in form of voice, data, image, multimedia, etc. Also it ensures safe journey by minimizing road accidents, diverting or instructing the vehicle’s direction in less populated roads avoiding traffic jam, etc.

Vehicles in a VANET are having high degree of mobility, i.e., the vehicles are moving very fast, especially in high ways. As a result the two vehicles are in a direct communication range staying about one minute time only, i.e., two vehicles remain in one cell about one minute time when they are moving parallel direction or even less than one minute when they are in opposite direction [3]-[5]. For this, VANET cell configuration and number of nodes present in a particular cell with applicable routing technique is changing in nature.

Neeraj Sharma et. al[3] in 2013 performed analysis the AODV and GPSR routing protocol used in VANET and concluded them.

Annu Mor[4] in 2013, proposed cross layer technique that find channel security at link layer to AODV routing protocol to improved the communication in vehicles for safety.

Gulhane S.P. et. al[5] in 2012, proposed the vehicular ad-hoc networks and the typical routing protocol. The ad-hoc on demand routing protocol(AODV) in mobile ad-hoc networks and the optimized protocol AODV-OBD for protocol AODV.

Aswathy M C et. al [6] in 2012,proposed at improving the performance of AODV by enhancing the existing protocol by creating table clusters and perform coming by clusters nodes and gateway nodes.

V.P.Patil [7] in 2012, proposed an innovative approach to deal with the problem of traffic congestion using the characteristics of vehicular ad-hoc networks. The system is developed and tested using AODV protocol of ad-hoc mobile network to deal with the problem of vehicle traffic congestions in vehicular ad-hoc networks. The performance is measured in terms of no. of packet broadcasted, percentage of packet delivery and percentage of packet diverted and overhead to manage the problem of data traffic congestion in computer networks.

Rakesh Kumar et. al [8] in 2011, an extended AODV routing protocol proposed for AODV networks which typically suits to resolve the realistic model problems. This propose protocol may improve the performance of regular AODV routing protocol. It has all features of AODV routing protocol, at is follows all the steps of the discovery algorithm of AODV routing protocol.

Uma Nagarajet. al[9] proposed the advantages/disadvantages and the applications of various routing protocols for vehicular ad-hoc networks. It explores the motivation behind the designed, and trace the evolution between routing protocols.

Uma Nagarajet. al[10] in 2012 , proposed to compare four well-known protocols AODV,DSR,OSLR and DSDV by using three performance metrics packet delivery ratio, average end to end delay and routing overhead.

We study Mohammad Al-Rabayah et al.[11] proposed a work similar like, reducing overhead AODV modification in their paper. But they propose rebroadcast using beacon frame, whenever link fails. In this approach the bandwidth will be underutilize. Hence our previous work on the same area, we have proposed some recovery process of link in AODV using rebroadcast, stack, dqueue[12,13].

3. PROPOSED WORK

Rayleigh fading is a model that can be used to describe the form of fading that occurs when multipath propagation exists. In any terrestrial environment a radio signal will travel via a number of different paths from the transmitter to the receiver. The most obvious path is the direct, or line of sight path[14]-[17] is useful in scenarios where the signal may be considered to be scattered between the transmitter and receiver. In this form of scenario there is no single signal path that dominates and a statistical approach is required to the analysis of the overall nature of the radio communications channel.

Rayleigh fading is a model that can be used to describe the form of fading that occurs when multipath

3.1 Simulation

In this study, we used NCTUns-6.0[2,18] for simulation. We have chosen this simulator because,

1. Highly integrated and professional GUI environment.
2. Support for various network protocols.
3. Support for various important network.
4. Same configuration and operations as for real life networks.
5. High simulation speed and repeatable simulation result.
6. High fidelity simulation results.

3.1.1 Performance metrics

Different performance metrics are used to check the performance of routing protocols in various network environments. In our study we have selected overhead and packet drop to check the performance of VANET routing protocols against each other. The reason for the selection of these performance metrics is to check the performance of routing protocols in highly mobile environment of VANET. Moreover, these performance metrics are used to check the effectiveness of VANET routing protocols i.e. how well the protocol deliver packets and how well the algorithm for a routing protocol performs in order to discover the route towards destination. The selected metrics for routing protocols evaluation are as follows [2,11,12,19,20,21].

Overhead

Overhead is the average number of successfully delivered data packets on a communication network or network node. In other words throughput describes as the total number of received packets at the destination out of total transmitted packets [1,11]. Throughput is calculated in bytes/sec or data packets per second. The simulation result for throughput in NCTUns6.0 shows the total received packets at destination in KB/Sec, mathematically throughput is shown as follows:

$$Ts=(Pk * Z) / Th \text{ (bytes/sec)} \quad (1)$$

Pk : Total number of received packets at destination

Ts : Total simulation time

Z : packet size

Th : overhead

AODV Routing protocol

Ad hoc On-demand Distance Vector (AODV) [2,11,,12,19,20,21].routing protocol is an important routing protocol used in VANET system. It is known that AODV is reactive routing protocol, that is based on topology based routing protocol. The AODV routing algorithm enables dynamic, multi-hop, self starting, routing between participating moving nodes wants to establish and maintain an ad-hoc network [22]. As AODV routing algorithm is dynamic in nature, so it also allows highly mobile nodes to create routes very quickly to find new destination, nodes which are not connected, is not necessary to maintain this routes. As AODV used in VANET system , therefore it allows the nodes to break a link from a network and can connect this node to another network. But during packet delivery time AODV does not allows the loop(closed path) and the shortest path is measured by Bellman-Ford algorithm counting to infinity problem‖.[Fig-2]

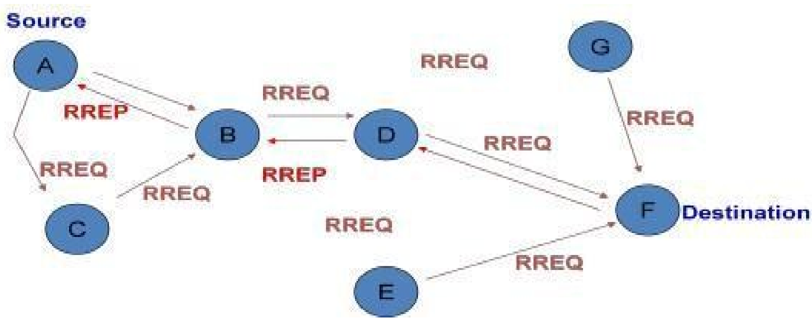

Fig.3. AODV working mechanism[22]

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 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |J|R|G|D|U|F|  Reserved           |   Hop Count   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                            RREQ ID                            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Destination IP Address                     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Destination Sequence Number                  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Originator IP Address                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Originator Sequence Number                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Fig 4: Modified RREQ packet format[22]

We have modified Route Request(RREQ)[1] header[Fig 3] with a new flag F. If a F is set the discovered Destination IP address is preserved in a dqueue. During unicast if link breakage occurs, according to flag F it pick neighbor node address(nearest originator IP) from dqueue. As the dqueue[12] is implemented the insertion and pickup is less complex to Stack[19].

We have modified earlier AODV-RREQ header[Fig 4] with a new flag F. If a F is set the discovered Destination IP address is preserved in a dqueue. During unicast if link breakage occurs, according to flag F, it pick neighbor node address(nearest originator IP) from dqueue. As the dqueue is implemented the insertion and pickup is less complex to Stack[19].

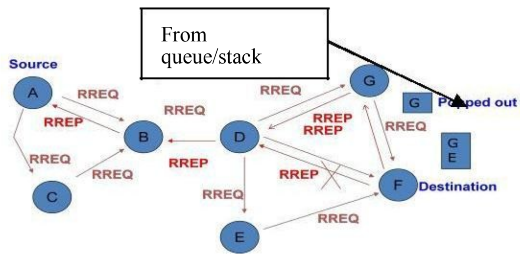

Fig. 5. On error[12],[19]

4. SIMULATION AND RESULTS

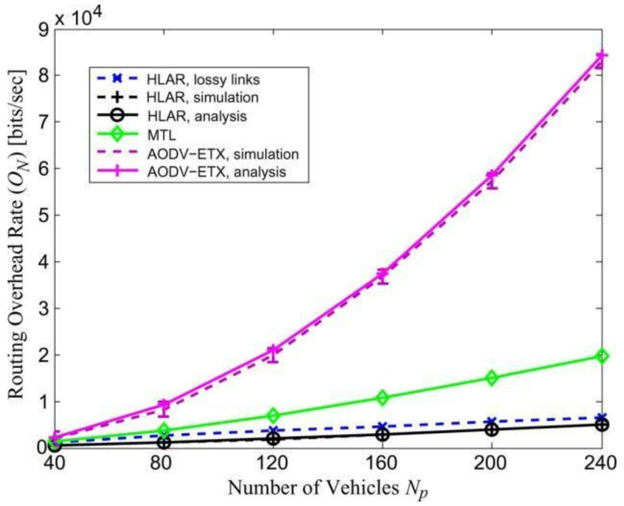

Fig. 6. Routing overhead vs no. of vechels ofMohammad Al-Rabayah et al.[11] approch

We found the above result (Fig 6) Mohammad Al-Rabayah et al.[9] result of the paper. The original AODV is much more overhead when number of car increases. In original AODV always reinitiate connection establishment when link breakage occurs. Mohammad Al-Rabayah et al.[11] approach of HLAR, the overhead is well reduced compared to AODV-ETX as it repair the link locally.

The following testing parameter is used to simulate our proposal (dqAODV)[12] which is similar like the parameter of Mohammad Al-Rabayah et al.[9]. And the simulation is done on highway scenario, given below Fig-7

Fig. 7. Testing high way scenario

Table 2: ai-dqAODV testing parameters

Parameter	**Settings**
Transmission mode	TCP/IP
Lane Width	20m
Simulation time	400sec
RTS threshold	4000bytes (O)
The car profile (Taken five)	40-100km/H
Number of lane	2
The protocol	Ai-dqAODV
standard used for each vehicular node	IEEE802.11b
cars are selected for three different scenarios	40-240
Transmission power used	7dbm (P)
TTL	3(T)
Frequency Channel	2
Hello Interval	2000
Route Timeout	4000
Hello loss	4
Link Bandwidth	7db
Transmission range	150—250m
Data	8kbps
MAC layer	802.11b
Bandwidth	2mbps
Speed distribution	Rayleigh

We find the results on overhead on incising numbers of nodes in Fig-8-14 is little higher than 1 (which is slight lower than 1 in Mohammad Al-Rabayah et al.[11] approach).

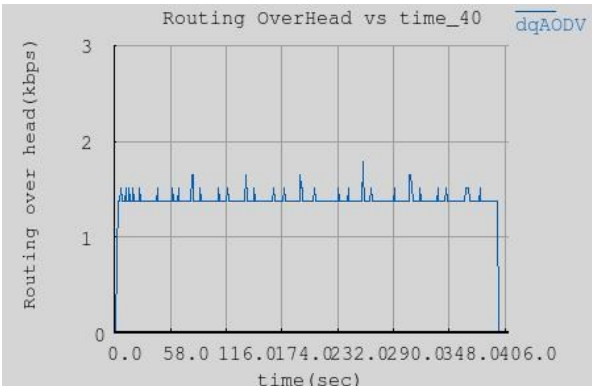

Fig:8 Routing overhead vs time for node 40

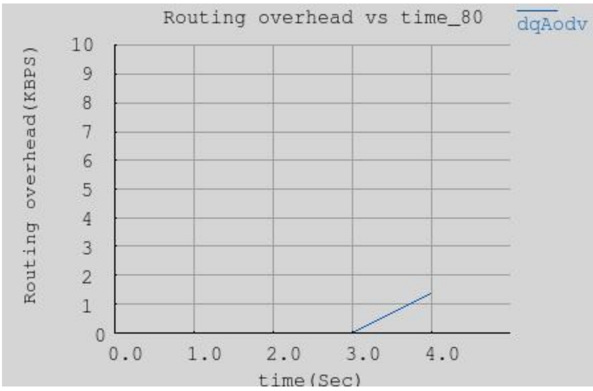

Fig:9 Routing overhead vs time for node 80

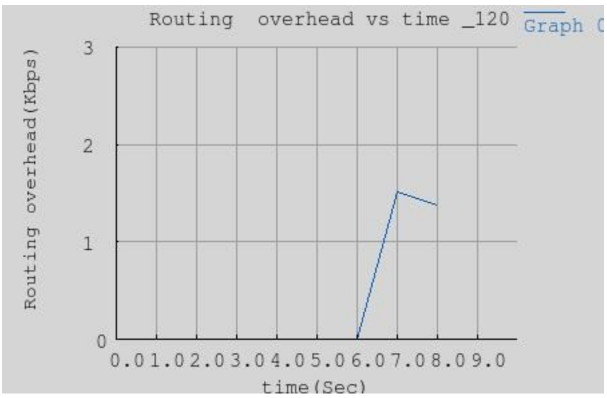

Fig:10 Routing overhead vs time for node 120

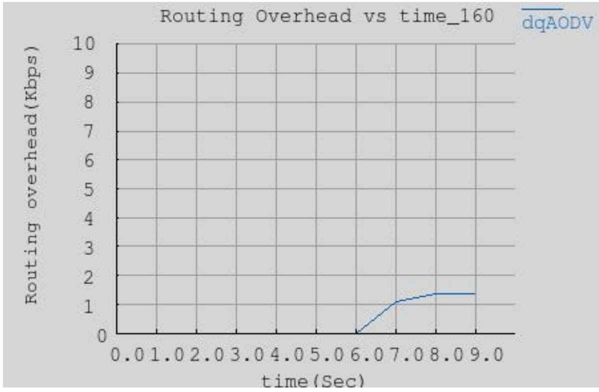

Fig:11 Routing overhead vs time for node 160

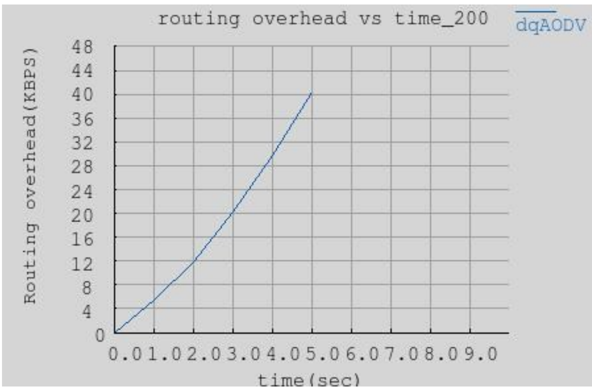

Fig:12 Routing overhead vs time for node 200

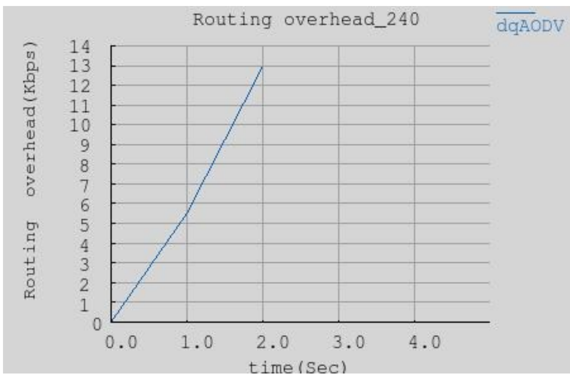

Fig:13 Routing overhead vs time for node 240

When we increase nodes to 200 or more, it is appeared a high increase of overhead, but as car moves, the overhead reduced. As the node number is large, initially have high communication of packets to establish link. But, as and when car movement progress, due to high density of car on same geographical area cause very low link brakeage. Hence it need not to re-establish the link. It causes very low overhead. Whereas found asymptotic increase of overhead in Mohammad Al-Rabayah et al.[11] approach.

We have obtain the result of routing overhead vs time in figure--14. In our proposed algorithm of dqAODV the result is average on 1.5Kbps(overload) compared to Mohammad Al-Rabayah et al.[11] approach (HLAR) is 0.8Kbps.

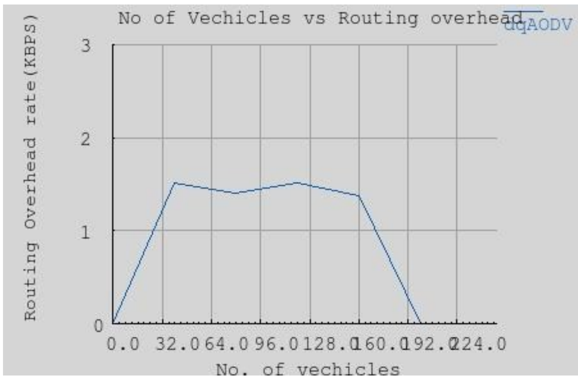

Fig.:14 Number of vehicles vs routing overhead in dqAODV

5. CONCLUSIONS

We have observed in our approach, the overhead is comparable with HLAR[11] whereas, in our approach, we simply opt the alternative path in spite of rebroadcast. It has a great advantage of quick reconnect with destination and it is most useful approach in ad-hoc network with high mobility. We further propose this model on highway scenario, and it is also useful in city scenario model in our previous work[2,11,,12,19,20,21].

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