Comparing AODV and ADV Routing Protocols in Urban Environment

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Abstract

In vehicular ad hoc networks there is the ability to communicate between vehicles. This Communication which is wireless should be rapid and reliable. These networks have unique characteristic. This communication among vehicles has many advantages in safety and comfort applications. Since, the roads are always encountered to accidents and risks, using optimized tools could be useful in these situations. In this study, AODV and ADV routing algorithms has been compared through their performance metrics in a city scenario, include delay, network loss, collision and throughput were investigated through NCTUns 6.0.

Keywords: Vanet, Routing Protocols, City environment, Safety Applications.

1. Introduction

Nowadays, wireless communication has widespread coverage in different technologies. There are research works on providing optimized routing protocols, reliable information dissemination, improving quality of service and some other subjects. In vehicular ad hoc networks each vehicle is considered as a node and in safety applications, researchers try to anticipate danger on the road and inform drivers as quickly as possible to decrease the risk of driving. This risk could be some hazardous on the road include lane changing, stopping and accident. There are challenges in designing appropriate routing protocols because of vehicles topology changing and high speed which leads to network fragmentation. It is worth to know which routing protocol will operate better in different situations, so offered routing protocols are simulated using software due to human safety as well as high cost. By rapid technology development, at the moment vehicles can be equipped by electronic smart tools to provide rapid and effective communication between vehicles using global positioning system.

1.1. Structure of Vehicular Networks

Structural standard of vehicular network does not need to stable station for information transmitting. Vehicular networks can use cellular gateway and wireless local area network access points at street intersections to collect traffic data, internet access and routing. In vehicular communication cellular or wireless local area network is called vehicle to Infrastructure (V2I) Communication. If the structure be in a pure ad hoc, so this is called vehicle to vehicle communication (V2V). There are some features which could be considered as distinguishing parameters among other networks include high mobility topology, frequent network fragmentation, motion modeling, communication environment, delay constraints, interacting with sensor processors are connected to vehicular networks [1]. Vehicular network communication is demonstrated in Fig.1.

1.2. Routing Protocols in Vehicular Networks

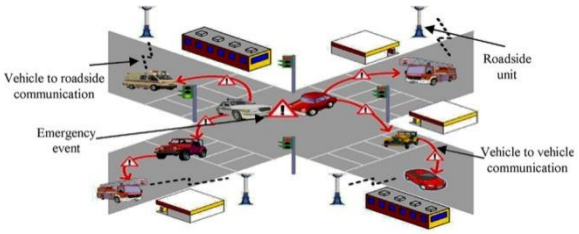

Fig.1. Sample of vehicular networks

Vehicular networks are based on wireless communication and unlike wired networks don't use of any specific routers. Classifying current routing is done based on different criteria. Routing protocols in vehicular networks are divided in two general type based on vehicle to vehicle communication and vehicle to infrastructure communication [2],[3].

1.2.1. Vehicle to Vehicle Communication

Topology-based routing protocols: this kind of protocols use link information in the network to send data packets and are divided to three sections like reactive routing table-oriented, proactive routing demand-oriented and hybrid routing.

Position-based routing protocols: in this kind of routing, all nodes distinguish geographical position and neighboring nodes by global positioning system.

Cluster-based routing protocols: totally, cluster based routing protocols are stable. Nodes inside cluster are connected together using direct links. Selecting cluster head node and cluster configuration is important in this regard.

Geocast-based routing protocols: generally, this protocol is considered as position-based multicast routing which distributes given message to all available vehicles in specific geographical area namely ZOR.

Multicast-based routing protocols: multicast is defined as kind of sending which transmitting is done from single source to several destinations. These protocols are in form of tree based multicast routing protocol and mesh based multicast routing protocols.

Broadcast-based routing protocols: these types of protocols are used in vehicular networks to share information about road, weather and emergency situation as well as commercial advertisements and general notification [4].

1.1. Vehicle to Infrastructure Communication

Due to high mobility and topology of vehicular network, network fragmentation is unavoidable. One way to solve this problem is to use access point beside roads to increase assurance and reduce delay of transmission [1].

2. Related Works

2.1. Reactive Routing Algorithms in Vehicular ad hoc Networks

Given various nature of ad hoc vehicular networks which leads to topology changing, routing issues will be complex too. Some of routing protocols like AODV, DSR and AOMDV are used in mobile ad hoc networks and they could be used in vehicular networks by changing some of features. Proactive routing protocols use ad hoc algorithms and when an event is occurred, route discovering process will be started. AOMDV protocol is an advanced model of AODV. In this model, there are several sources and destination. Route recovery and route detection algorithm is with higher and rapid efficiency [5]. Using this technique, retransmitting unsuccessful packets by neighboring vehicles, tries to improve efficiency of AOMDV routing protocol. Using this method is suitable for transmission rate in high speed, but overhead is not reduced [6]. In order to improve efficiency of AODV routing protocol in ad hoc vehicular networks, in [7],[8] respectively optimizing method from discovering step of routing and selecting route and creating route with high stability in the challenging environment was used. Also S-AODV routing protocol was used to increase safety [9], and PRAODV routing protocol in which link state life time and information speed of vehicle is estimated, was used [10].

AODV Routing Protocol: There are lots of routing protocols in ad hoc networks. AODV is one of the important routing protocol among others. This protocol is reactive topology based protocol and acts based on demand. In this routing protocol, not all routes available always. Main advantages of this routing protocol are using node sequence number which routing are always updated and loops are not created. AODV routing protocol consist of three phases like route discovering, data transmission and route maintenance [11].

ADV Routing Protocol: This routing protocol is one of the hybrid topology-based routing protocols which has advantages of reactive and proactive protocols. In this protocol, routing is started by proactive protocols like DSDV and then demand based method is used to reduce overhead induced by proactive routing. In this protocol like AODV, control messages are used to maintain table in update situation [12].

3. New Work

Sending safety messages in vehicular environments are most important issues in intelligence transportation system. These messages help driver to drive comfortable and safety and inform about

available risks in the roads. Risk situations in the road are in different forms like unfavorable weather, high traffic or blocking road, accident or narrow road.

In this article, emergency situation was provided using a vehicle stopping in the urban scenario through AODV and ADV routing protocols and compared to god routing (kind of a routing to compare without any overhead). Purpose of this study was to select optimized routing protocol in emergency situations in urban scenarios. In order to evaluate efficiency of routing protocols, performance metrics like transmission delay, throughput, packet loss and collision were studied. In this regard, two scenarios of urban through changing density and area of transmission in vehicles, best situation in safety application using AODV and ADV routing protocols have been investigated.

4. Simulation

Recently, wireless communication technology has been developed. This development has some effects in human life. One of application of wireless communication is vehicular networks. These communications provide welfare and safety and most of this application could be applied in vehicles, but due to importance of driver and passenger lives, this should be investigated. Simulation software is used to observe performance of new methods. simulation could be converted to reality by regarding vehicle mobility, road, topology of routing, traffic model, conjunction, traffic light, driver behavior, vehicle various speed, available symbols in the road etc…. NCTUns 6.0 software was used to simulate this algorithm. This software is a vehicular network simulator which is combination of mobility model simulator and network simulator. This software has rapid simulation and is able to simulate repeatedly. Performance metrics are: transmission delay: this is needed time to receive sent message from sender by receiver in term of M/S. collision: this value is equal to number of incident packets in second. Network loss: number of dropped packets in second that caused by problem in network or collision. Throughput: value of data which is transferred in certain time from source to destination and is evaluated in term of kilobyte/second [13]. To consider reality qualifications there are some environment parameters which are shown in Table 1.

Table.1
Physical parameters used in simulation

Parameter	Value
Frequency (MHz)	2400
Fading Var	10
Ricean factor k (dbm)	10
Tx Antenna Height (m)	1.5
Transmission power (dbm)	3
Shadowing standard deviation	4
Path loss exponent	2

4.1 Urban Scenario

This scenario is considered in part of city environment in which there are 30 vehicles in 9 intersections and also traffic lights have been used to conduct vehicles. Using traffic lights, vehicles are stopped based on them and continue to moving. Also vehicles have ability of lane changing. After 10 seconds when the simulation one of the vehicles is stopped and immediately started to send messages to vehicles which are behind of stopped vehicle. Vehicles followed Car-Following mobility model, kind of IDM model. Area of transmission in this state is 150 meter. This scenario is illustrated in Fig.2.

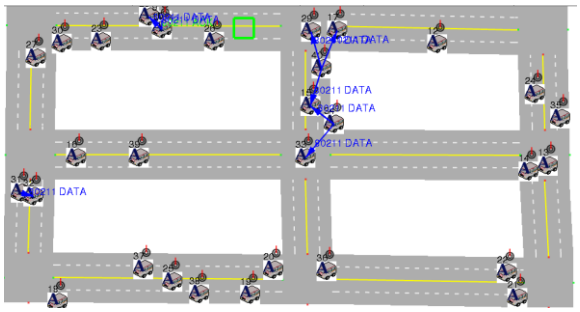

Fig.2. Urban environment using NCTUns 6.0

Effect of changing Density on Performance Metrics: Comparison was done by changing density of vehicles from 30 to 70 vehicles and god routing was used to compare in which shortest route is considered without overhead increasing.

As shown in Fig.3.a collision increases by density increase and as can be deduced in both AODV and ADV routing protocols packet loss will be increased although this rate is higher in AODV. One of the reasons of packet loss is collision. So there is a direct relevance between them. This can be seen in Fig.3.b. Throughput has high value in density of 40 and 50 vehicles and by increasing in density this value drops in both routing protocols. This reduction is because of arising packet exchange which leads to more collision

and packet loss. Also transmission delay will arise by increasing vehicles density but AODV has higher transmission delay and it could be deduced that ADV has better performance than AODV.

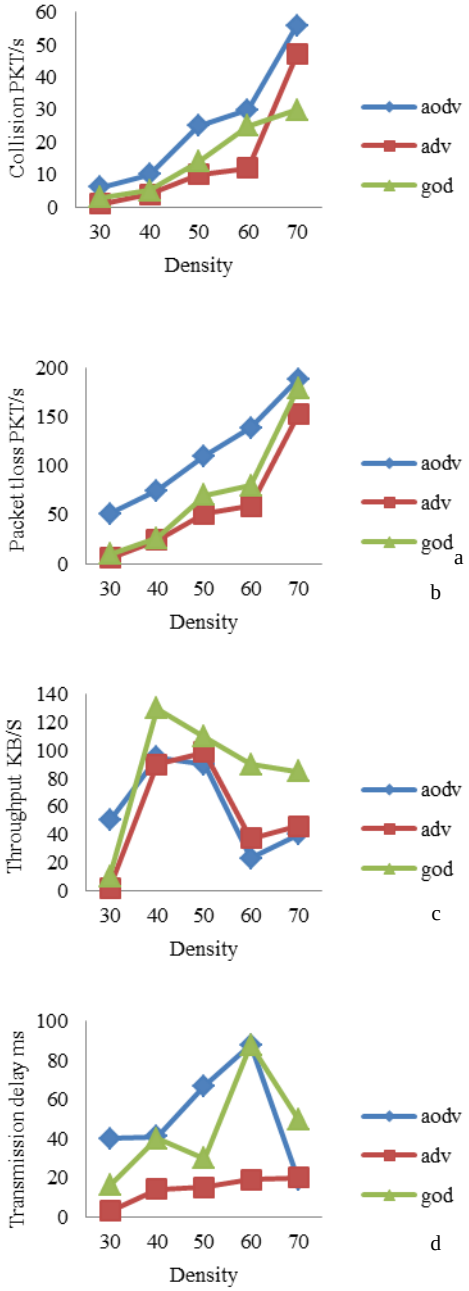

Fig. 3. Effect of changing density on performance metrics

Effect of Changing Transmission area on Performance Metrics: Covering issue is always important in packet sending. When there is not an appropriate sending area, messages deliver to destination with delay. Also, increasing sending area leads to increase sending packets and will lead to collision and loss. Therefore, finding optimized sending area is essential and plays important role in covering. In order to compare states, sending area is from 100 to 300 meters In order to observe increasing effect of transmission area on performance metrics of an urban environment with 40 vehicles and stable area and nine intersections.

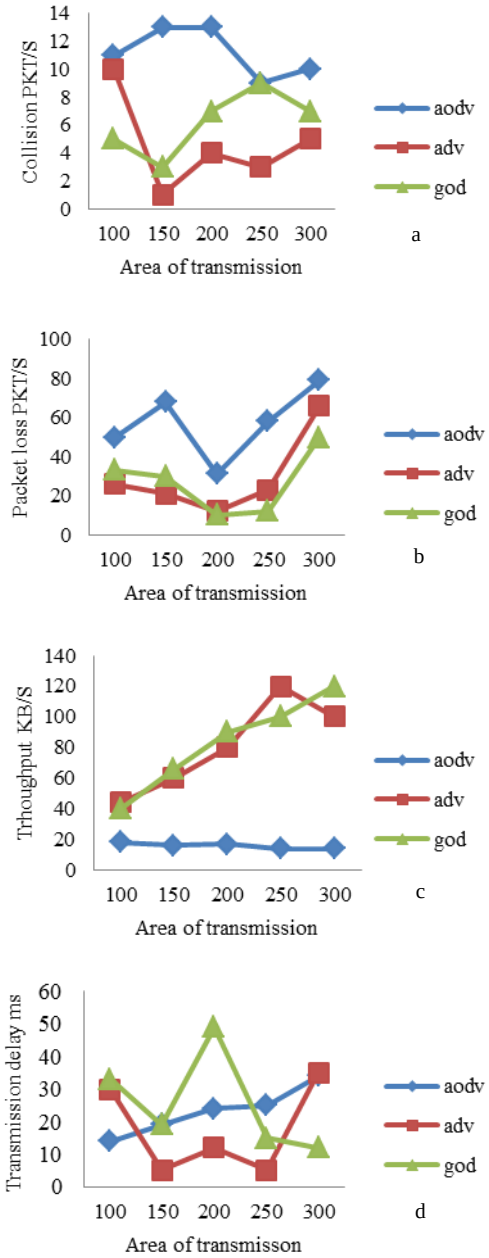

Fig.4. effect of changing transmission area on performance metrics

As shown in Fig.4.a by changing the area from 100 to 300, collision is normally increases and as a result of it packet loss is increased. This value is higher in AODV and Packet loss was reduced in 200 meter transmission area and this means decreasing packet loss. Throughput has its maximum value in 250 meter. In Fig.4.c ADV has higher Throughput. Totally, ADV

acts well when high throughput is needed for example video transmission and AODV acts well when delay doesn't have high priority.

5. Conclusion

Vehicular networks main goals focused on safety and welfare applications. In this article one safety application, stopped vehicle situation, has been studied. In fact performance evaluation in ADV compared to AODV routing protocol has been focused. Regarding to the results, ADV routing protocol has better performance when density of vehicles is increased. This density increasing is suitable when don't lead to increasing packet loss and transmission delay. Totally, regarding compromise between different evaluation metrics, best performance of routing protocol will be obtained. In urban scenario, by increasing transmission area and density ADV shows better results compared to AODV.

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