ADAPTIVE INTERSECTION-BASED TRANSMISSION QUALITY PROTOCOL IN VEHICULAR AD HOC NETWORK

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Abstract

Vehicular Ad Hoc Networks (VANETs) have been attracting more and more attention due to their potential in providing safety and infotainment applications. However, because of the fast movement of nodes, limited network resources as well as complicated channel environment, designing an efficient routing protocol in the complex urban environment is quite changing. In this paper, an Adaptive intersection-based Transmission quality protocol in urban VANETs(ATQ), is proposed. As a selection guidance of the best route, each road segment is assigned to a weight based on the collected information, related to the delay and connectivity of each road segment. Different from other Mobile Ad Hoc networks (MANETs), VANETs have its inherent characteristics, including dynamic topology change, the high mobility of nodes, constraints of road layouts as well as obstruction of roadside obstacles against wireless signals, etc., which will affect the transmission quality of data transmission. An improved greedy forwarding strategy is further proposed to forward the packet along the selected road segment, ensuring the fast and reliable packet transmission. Simulation results show that the protocol proposed outperforms existing protocols in terms of the packet delivery ratio and end-to-end delay.

Index Terms:Vehicular Ad Hoc Networks, geographic routing protocol, quality of transmission, link quality.

I. INTRODUCTION:

VANET have been physical World Cyber World, Cellular BS, VTOIRSU attracting more and more attention due to their potential in providing safety and infotainment applications [1, 2], where each vehicle installed with a communication device can act as a portable node or router to communicate with other nodes events. As one key component of intelligent transportation systems (ITSs), events are envisaged to play an important role in enhancing road safety and providing innovative services, including safety, traffic management and infotainment applications. For example, VANETs are useful for disseminating alerts to drivers during specific events, e.g., traffic jams, hazardous traffic environment, or accidents. Besides, VANET scan also offer different kinds of comfort applications, such as info-mobility, mobile e-commerce, infotainment and interactive services. Three communication ways, referring to the vehicle. There have been a large number of routing protocols designed for VANETs[3 ,4].

Generally speaking, they can be classified into two categories: topology-based routing and position-based (geographic) routing. Topology-based routing makes use of the link state information for data forwarding. However, it has been demonstrated that this routing can't work well in a vehicular environment [5]. The main problem lies in the route instability. Because of frequent link breakages caused by fast node movement, the data transmission easily fails. Then, the overhead used for route repairs or failure notifications will be increased, resulting in a lower packet delivery ratio as well as incurring higher transmission delay. Moreover, the routing scalability is also one problem [6]. When the network size grows, the performance of the topology-based routing will degrade. By comparison, with the increasing availability of digital map, navigation system and other location services, position-based routing is an alternative approach in VANETs[7], where data packets are forwarded without establishing and maintaining any routes but depending on the positions of nodes.

The practical urban road environment includes two main parts: intersections and road segments. In order to design an efficient position-based routing protocol, two key issues arise:1)how to select next road segments at one intersection, and 2) how to choose the next hop to relay data packets along the selected road segment. For the first issue, the routing metric designed based on the specified application requirements play a key role in providing quantifiable values to judge the efficiency of the route. Some routing protocols design the routing metrics by the history information, which can low the communication overhead. [8] Forwards the packet along the road segment with the lowest transmission delay [9] determines the best routing path that has the maximum connectivity subject to some quality of service (QoS) requirement. However, these protocols suffer from local maximum and data congestion.

When there is no node available to forward the packet toward the destination than the current one, the local maximum will occur. If the same routing path is used to forward data packets different source-destination pairs, the data congestion may arise. Besides, for these routing protocols, the real best route may not be taken under inaccurate estimation of each road segment's history information related some key parameters. For other routing protocols, such as [6, 10, 11 , 12], they need to calculate the routing metrics using the real-time information related to the traffic condition and channel environment. Considering the distribution and mobility of nodes, it is probable that there are several link partitions, especially in the sparse situation. In this case, it is difficult to calculate the routing metrics.

For the second issue, generally speaking, it includes two key parts: 1) how to choose the next hop when the packet is moving along the selected road segment; and 2) how to determine the next hop when the packet reaches one intersection. Correspondingly, there are three models for packet forwarding as shown in Fig.1, i.e., intersection model, road segment model, and destination model. For the former, with the objective of reducing the number of relay nodes, the greedy algorithm is widely used to select next hop, where the node with the great geographic process toward the destination is preferred. However, due to the high mobility of nodes, each node is very likely to move out of the transmission range of its neighbours during one inter-beacon interval. This will lead to its neighbours information extracted from last beacons being out of date, thus resulting in the wrong routing decision. Therefore, one improved greedy routing strategy should be designed. For the latter, because of the unpredictable nature of VANETs, it is not expected that the packet could always be routed through one pre-computed optimal path. For example, considering the varying traffic condition, there is a higher probability that when a packet reaches one intersection, no any vehicle is available to forward the packet in the next road segment along the determined route, leading to the local maximum issue.

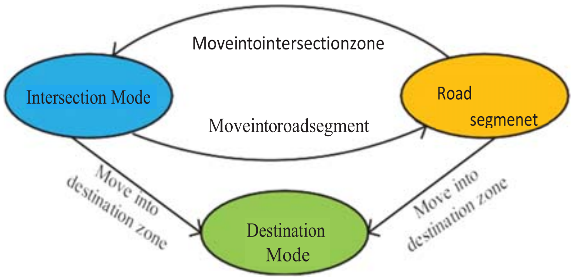

Fig. 1. Different models for packet forwarding.

Based on the description above, different existing works, we propose an adaptive intersection-based transmission quality guaranteed geographic routing protocol in urban VANETs (ATGR), which takes full advantage of the real-time and historical traffic information. As the selection guidance of next intersection, each road segment is assigned with a weight based on the connectivity model via the statistical history information in case of the disconnected link and the delay model through the collected real-time information when the link is connected. According to the weight information, the next intersection is selected dynamically one by one. This can lower the probability of data packets to suffer from the local maximum and avoid the risk that the same routing path is overcrowded by frequently data packets from different source-destination pairs. When the packets are forwarded along the selected road segment, one improved greedy forwarding strategy is employed, the novelty of which is to take into consideration the mobility characteristic of nodes and the per-hop progress to guarantee the fast and efficient data transmission.

The main contributions of our work can be generalized as follows: We assign each road segment with a weight by collecting the information of connectivity and delay. Using the proposed road weight evaluation procedure, we can check whether the road segment is connected. When the road segment is connected, in order to capture the channel quality, the average delay needed for a packet to forward across the road segment is the crucial parameter. Otherwise, for the purpose of increasing the probability of nodes to connect with each other, the connectivity will be considered as the key factor to measure the performance of the network.Based on the weight information of road segments, the road segment can be dynamically selected one by one to comprise the best routing path. Adopting this way can adapt to the dynamic environment in VANETs, avoiding local maximum and data congestion. One next hop selection scheme is proposed to forward the packet along the selected road segment. Considering the mobility of nodes, the node with the maximum per-hop progress and link connection time with the sender is preferred as the next hop, ensuring the fast and efficient packet transmission.

II. LITRATURE SURVEY:

There have been a number of researchers in designing one popular routing schemes in VANETs A number of routing protocols have been designed by using the traffic information [13] makes the selection of next intersection dynamically by considering the remaining distance from each candidate intersection to the destination and the variation in vehicular traffic. When the packet is forwarded along the selected road segment, an improved greedy

The strategy is adopted. Utilizing the protocol can help finding optimal route. However, it is not enough to select the best routing path by only depending on the density information. [14] focuses on minimizing the data delivery delay in sparse networks, which can adapt the varying vehicle density by estimating the delay in packet transmission along the road segment. However, it needs to use static nodes at intersections to assist packets, forwarding when there are no vehicles available along the best routing path. The packets can be stored in the buffer of one static node until a suitable vehicle is available [15] includes two algorithms, that is, the optimal forwarding algorithm and restricted forwarding algorithm. The former is employed to deal with the local maximum and link disconnection caused by the dynamic characteristics of VANETs, based on the estimated vehicle density under different road conditions. The latter is used to select one relay in a given range with the objective of reducing the packet loss arising from the unreliable wireless environment. However, the protocol will increase the number of hops in the network, thus leading to the extra delay. In addition, it lacks a recovery scheme to address the route failure. With the availability of city map, navigation system and other location service, the trajectory information can be used to support data forwarding [8] utilizes the idea of carry-and-forward to forward a packet on a basis of the use of predictable vehicle mobility when there are no available nodes within the transmission range of the packet carrier.

Once the packet arrives at one intersection, the next forwarding path with the lowest delay to the destination is selected [16] improves VADD by taking into account the trajectory information of vehicles, where each vehicle is capable to predetermine its routing path through which the packet is forwarded. However, without sharing the trajectory among vehicles, each vehicle should make its own routing policy. [17] can better use the shared trajectory information in a participatory way, thus avoiding the uncertainty of statistics as well as making the forwarding more accurate. However, such a full sharing of trajectory information in public will result in the privacy problem. [18] investigates the routing problem with the least delay by exploiting vehicle traffic statistics, any-cast routing, and future trajectory information about vehicles. On the basis of the proposed network model and derived delay function, a Markov Decision Process (MDP) is formulated. An optimal routing policy can be developed by solving the MDP.Some protocols have been proposed with road intersections and roadside infrastructures. [9] adopts a genetic algorithm to select the best routing path that maximizes the connectivity while satisfying the given QoS requirements, such as bit error rate, end-to-end delay, and hop numbers.

The routing path is composed of a series of intersections, thus reducing its sensitivity to movement of nodes. However, considering that it is a source-driven routing protocol and needs to know the complete route before sending the packet, it cannot work well in the rapid changing network environment [19] can find one route with the least number of intermediate intersections. The optimal route can be discovered by the hop greedy routing scheme proposed while taking into account connectivity status which can be provided by backbone nodes around an intersection. In addition, to solve the issue of the source and destination movement, an update procedure is also proposed [20] uses Connected Dominating Set to build a stable backbone on each road segment connected at intersections via bridge nodes. Based on the information collected by bridge nodes, before sending data packets, the end-to-end delay for each route from the source node to the destination node can be computed. Then the one with the lowest delay is selected as the best routing path. However, SCRP has no mechanism to maintain the backbone.

By exploring the broadcast nature of wireless channel and the diversity of packet reception, opportunistic routing provides an alternative approach, which can improve multi-hop communication reliability[11] can provide stable communication paths by the proposed scheme named as Long Lifetime Any-path to deal with the stability of any-path communications for VANETs. Its key novelty is to the proposal of one special metric of link cost that combines the packet delivery ratio and link stability information. However, because the selection of forwarders is based on the back-off timer, LLA cannot perform well in the high-density environment. [10] introduces a novel concept of link correlation to reflect the impact of relative link positions in a network topology on the resource consumption and throughput during transmitting a packet. With the concept, an opportunistic routing metric named as expected transmission cost is designed as the selection guidance of the optimized route.

Because of the similarity between the manner of finding routes in VANETs and species behavior to meet their natural needs, many bio-inspired algorithms in vehicular environments have been investigated for routing problems [21],[22] uses an Ant Colony Optimization(ACO)algorithm to find the optimal routing path, consisting of a succession of intersections. The discovered route is evaluated by two QoS performance metrics, that is, connectivity probability and transmission delay. When forwarded along the selected road segment, a greedy carry-and-forward scheme is employed.

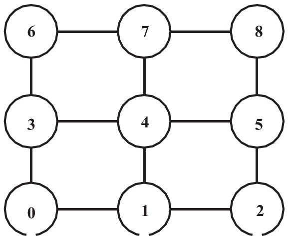

Fig. 2. A typical Graph of road topology

In Figure 2, where V is the set of intersections denoted by the numbers, and E is the set of road segments. Each link in this graph represents one road segment with two neighbouring intersections.

III. PROPOSED PROTOCOL:

1) Protocol overview:

In this section, an adaptive intersection-based transmission quality guaranteed geographic routing protocol for urbanVANETs is proposed. The objective of the presented protocols to find the best routing path, consisting of a series of intermediate intersections. It mainly includes two key components: route selection criterion and route transmission strategy. Route Selection Criterion: Because of high movement of nodes, the network is prone to encounter frequent link fragmentation. For the sparse vehicular traffic, for example, in rural areas or on highways during late-night hours

The fragmentation problem also often occurs. In addition, even though in the dense network environment, the low penetration ratio for DSRC technology at the initial stage could lead to network fragmentation. When the network is connected, the packet is transmitted through intermediate nodes with the help of wireless communication. Suffering from a network partition, a carry-and-forward strategy is used, where the packet is carried until a new node moves into its transmission range and then forwarded to the node. Compared to wireless communication delay, which is in the order of milliseconds, the delay incurred by the carry-and-forward scheme is longer. Thus, the connectivity that decides which transmission strategy to use is an important metric to influence the interior performance [23, 24], particularly for a light load case. Measured by the probability of nodes being connected, the connectivity is directly dependent on the density of vehicles, by which the quality of supplied service can be predicted. As shown in Fig.5, there exist two available paths from the source node S to the destination node D.

It can be found that although the length of the black routing path is shorter, due to the sparse vehicle density, there actually exist some isolated platoons.Thus, the carry-forwarder scheme has to be employed to forward the packet sent from S to D, increasing greatly the experienced a delay. In contrast, considering the blue one fully connected, the packet can be quick transmitted with a lower delay incurred from the wireless transmission spite of its longer path length. Therefore, when forwarding packet sent from the source node toward the destination through a number of intersections, the route with the higher connectivity is preferred. However, without considering the influences from channel fading and interferences from other vehicles, the connectivity cannot comprehensively reflect the network performance. For example, the higher node density can improve the connectivity, but the channel quality may be aggravated by heavy data flows. When the same routing path with the highest connectivity is used by multiple source-destination pairs, the data congestion may occur, leading to greater channel competition and causing more transmission failures. To address the issue, except the connectivity, we also use the average delay experienced by the packet to determine the best routing path.

Because of unpredictable nature of VANETs, it is not expected that the packet could always be routed through one pre-computed optimal path. Considering the varying traffic condition, there is a higher probability that when a packet reaches one intersection, no any vehicle is available at the relay in the next road segment along the determined route, leading to the local maximum. As shown in Fig.5, vehicle A has a packet to the destination D. Assume the optimal route which is pre-computed is I0 I2 I3. A wants to send the packet, but there are no available contacts in the road segment with intersection I0 and I2. Although there is one available route, that is, I0 I1 I3, the existing routing protocols, e.g., IGRP[9] do not utilize it. On this occasion, an alternative solution is necessary to continuously execute the dynamic path selection algorithm during the packet forwarding process. Through partial successive computation for discovering the optimized routing path at each intersection, we can select adaptively the next road segment which the packet has to traverse by exploiting more updated traffic information, such as the vehicular traffic status and the current position of the destination. Based on the description above, we design the algorithm process illustrated in Fig.6. Next, we give the detailed description of each component of the proposed protocol.

2. Protocol Components:

Road Weight Evaluation (RWE):

RWE is a heuristic distributed scheme with the aim of evaluating the availability of road segments for forwarding the packet. It is started with a unicast connectivity probe packet (CPP) triggered by a vehicle vi at intersection I to the adjacent intersection j, probing the connectivity of the road segment between two intersections as well as collecting some routing and traffic information. CPP is delivered hop by hop based on the next hop selection strategy (described later) to traverse the road segment to the other intersection, with the objective of collecting some information. When CPP reaches intersection j, vehicle vj closest to the centre of the current intersection is responsible for generating the updated weight of the road segment, e.g., the average experience delay and calculating the expected minimum link lifetime.

Then, vehicle JV announces the information across the intersection and sends it back to the originator vehicle vi. Otherwise, if failing to reach the destination intersection, the CPP will be dropped due to the longer delivery delay caused by a local network partition. When the CPP is generated, a timer T is set. It is found that the CPP includes two phases, that is, the

Denote a pair integers (m, n) as one state of the dynamic behavior of the back-off process, where m is the back-off stage number and n indicates the back-off counter value. Beginning with zero, the value of m is incremented by one every time the packet is retransmitted until it reaches the maximum back-offstage. If the packet can be transmitted successfully before the maximum transmission limitation, m will be reset to zero. The value of n initially randomly distributed in the range [0, Wm1]at stage m, follows one uniform distribution as follows:f (n) = u(0,

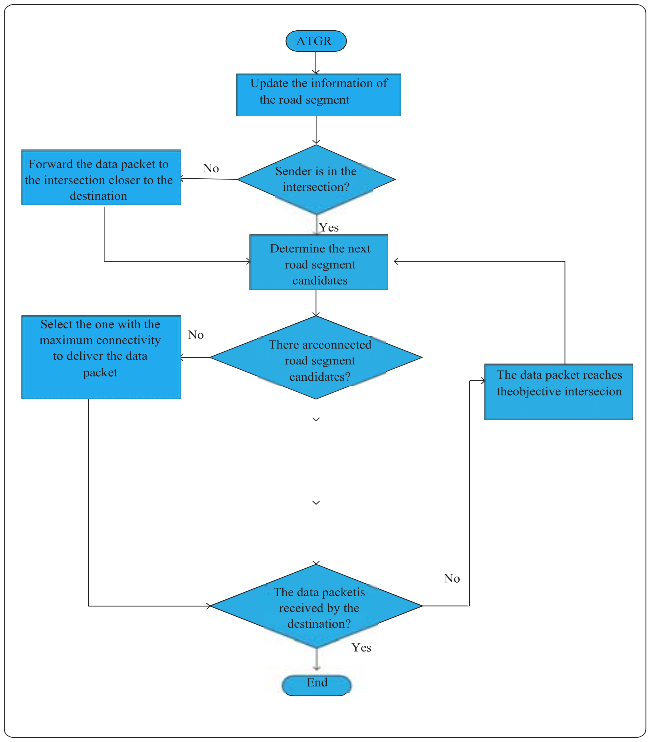

Fig. 3: The Decision Algorithm for the proposed Protocol

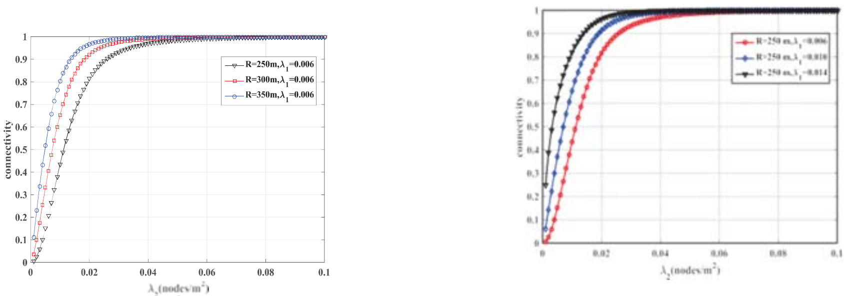

Fig. 4 (a) transmission range vs connectivity (b) traffic density vs the connectivity

Example of the connectivity for one road segment selection of next road segment the packet has to traverse can be done by exploiting more updated traffic information. When a packet arrives at one intersection, there are different

candidates intersections defined as the adjacent intersections. Here, we define the adjacent intersections closer to the destination than the current intersection as the candidate intersections. The selection of next intersection determines the forwarding direction of packets, exerting an important influence on the network performance. By this way, the routing path consisting of a series of road segments selected one by one not only has one best weight but also captures the variation of vehicular traffic. With the aim of finding one efficient route, the connected one among all the routing paths is preferred. This is because when the network is connected, the transmission of data packets depends on wireless communication technology. Otherwise, the carry-and-forward is employed to forward data packets once the carrier is faced with a link partition. Compared with the delay incurred during the carry-and-forward process, the one experienced by the wireless communication, which is in the order of milliseconds, can be almost ignored.

Algorithm1 : Minimum Distance Routing Algorithm

Notation:

Given one source intersection s and the destination d, graph G=(V, E) and length Lij for each road segment, i, j, E with intersection i and j

1: Execute the generalized Dijkstra's shortest-path algorithm, starting from the adjacent intersections of d. Calculate the minimum distance by:

$d(i, d) = \min\{Lij + d(j, d)|j \in N (i)\}$, and the corresponding neighbor intersection:

$i' = \mathrm{argmin}\{Lij + d(j, d)|j \in N (i)\}$, for each intersection i

2: Output the best routing path psd from s to d. For eachintersection i, record d(i, d) and i′.

3. Select the optimized road segment

Intense situations, it is very likely that the routing path with the maximum connectivity may be the one with the maximum level of congestions. This will lead to large delay and low available bandwidth. Therefore, to deal with the issue, when there exist more than one connected routing paths whose set is denoted by c(i), we will further select the one with the smallest average delay of data packets to traverse the routing path computed by Equation as the optimized route, i.e., optimal = argminl ∈ c(i), where it represents the average delay along the routing road segment which can be calculated.

However, in sparse environments, it is very probable that there are many link partitions in the network. It is promising to employ the carry-and-forward scheme to guarantee the packet delivery ratio at the cost of a higher delay. In this case, the connectivity will exert a significant influence on the network performance. Thus, if all the routing paths are disconnected, we will choose the one with the maximum connectivity based on optimal =argmaxl∈l(i)pl, where pl indicate the connectivity of the routing path road segment which can be calculated by Equation.

Algorithm 2

Notation:

VS: the source node;
VD: the destination node;
Vc: the packet carrier;
RS: the road segment;
recur: the current RS where the packet is moving;
can: the candidate RS set;
RSi: the RS I within RScan;
ti: the average delay needed for the packet to pass through RS I;
pi: the connectivity of RS I;
CRcur: the connected RS set within RScan;
DRcur: the disconnected RS set within RScan;

```
if VD is within RScur then
    Directly forward the packet to VD
endif
if the packet is travelling along RScur then
    Forward the packet toward the intersection of RScur
    closer to the destination
endif
if the packet reaches one intersection then
    Identity RScan of the packet
endif
while R Scan! = do
    Check the status of RSi in RScan
    if RSi is connected then
    Calculate the average delay ti of RSi by Equation above and add R
```

IV. PERFORMANCE SIMULATION:

In this section, our proposed ATGR protocol is implemented on a vehicular communication test bed combing Matlab andNS2 on Linux platform. The performance of our protocol will be evaluated compared with the scheme GPSR[10, 36], CAR[37] and JBR[38], where GPSR is improved with the carry-and-forward scheme, both of CAR and JBR intersection-based geographic routing protocols.

1. Simulation results and performance analysis

ATD of all the protocols is increased. The reason is that more generated packets during a specific period will lead to the increase of the channel load and the additional delay to interface queues incurred by collisions and retransmissions. For GPSR, without considering vehicular traffic, data packets may encounter the local maximum caused by the sparse density or experience the data congestion due to the lack of load balancing, thus increasing the delay. As for CAR, it depends on connected road segments to forward data packets, so it shows a better performance than GPSR. However, it cannot update routing information in real time. This will make the upcoming data packets suffer from network partition, causing a higher delay. Due to the use of its coordinator-based selective greedy forwarding strategy and angle-based recovery mechanism is employed to reduce the time needed for dealing with the issue of local optimum as well as shortening the ATD by a directional forwarding toward the destination.

However, the long-distance greedy forwarding will degrade the network performance. Compared with the other three protocols, our proposed protocol named as ATGR exhibits the best performance. This is because our proposed protocol employs an adaptive intersection selection scheme, by which the intersection can be determined one by one based on the information collected of connectivity and delay the road weight evaluation procedure. For ATGR, when selecting the next road segment, the connected road segment with less experienced delay is preferred. Moreover, if there is no connected road segment, our proposed protocol chooses the one with the maximum connectivity as the next road segment to forward the packet, minimize the usage of carry-and-forward strategy, lowering the transmission delay.

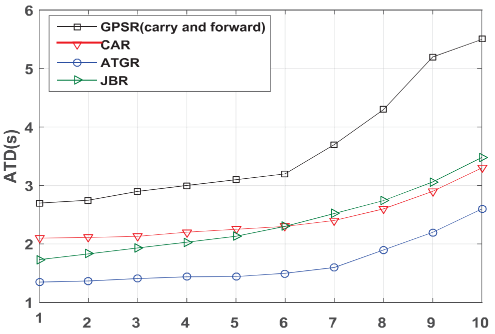

Fig5. ATD vs PGS.

It can be noticed that with the increase of PGS, the PDR of all the protocols is reducing. Because of the mobility and distribution of nodes, it is probable that there are some links partitions in the network. Under this condition, it is needed for the node which is carrying the packet to store the packet in the buffer until the next hop is found. Due to the limitation of the size of the buffer, the new coming packets will be dropped when the buffer is full. As s result, the increase of the PGS will lead to the reduction of the PDR. For GPSR, during forwarding data packets, because of the excessive use of the carry-and-forward scheme, many data packets may get dropped, so it performs the worst PDR.

Lacking the load balancing capacity, CAR may encounter data congestion or experience local maximum, thus exhibiting lower PDR that our proposed protocol ATGR. Although JBR adopts a recovery scheme based on the selective greedy forwarding by coordinators, its PDR is unsatisfied in this case. Actually, if there is no available node to be selected as the next hop, the sent packets will be dropped without the carry-and-forward transmission. Besides, the impact of traffic lights on the network connectivity makes the selective greedy forwarding fail, degrading the network performance. In order to capture the variation of vehicular traffic, our proposed protocol ATGR utilizes an adaptive intersection strategy. Using the road weight evaluation scheme, each road can be assigned with a suitable weight value based on the information collected of connectivity and delay. Then, due to the accurate weight estimation, the intersection can be determined one by one. When the density is sparse, implementing ATGR can alleviate the local maximum by selecting the maximum connectivity. In case that the density is dense, ATCR determines the road segment with the least transmission delay as the next road segment to forward the packets, avoiding the congestion. Using the protocol proposed can reduce the packet losses.

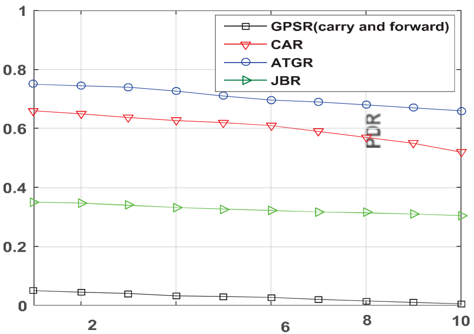

Fig 6 . PDR vs PGS.

Fig. represents the ATD by all the protocols as a function of different vehicle density (VD). It can be found that the ATD of all the other protocols is decreasing when the VD is growing. It is known that when the VD is sparse, the data packets should be stored and carried until finding an appropriate next hop upon encountering a link partition. As the VD is increasing, the network connectivity is improved, which can decrease the number of link partitions and enlarge the probability of vehicles to communicate with each other directly via wireless communication. Thus, the transmission delay from the source node to the destination incurred by the carry-and-forward scheme can be reduced. Compared with the other protocols, our proposed protocol ATGR shows the best performance.

This is because that ATGR can efficiently deal with the network topology changes and adaptively make a suitable routing decision at intersections. The next road segment is selected dynamically based on the weight information of connectivity and delay, avoiding network partition and alleviating data congestion. For CAR, it uses connected paths between the source node and the destination to forward data packets. So, it shows a better performance that GPSR. However, without updating routing information in real time, some data packets may experience network partition, raising the delay. As for JBR, it shows a larger value at first but experiences the fast drop with the increase of the VD evens lower than CAR finally. The coordinator-based selective greedy forwarding will have more chances to make the data packets to traverse some intersections to reach the destination. As for GPSR, the excessive use of carry-and-forward leads to the worse delay.

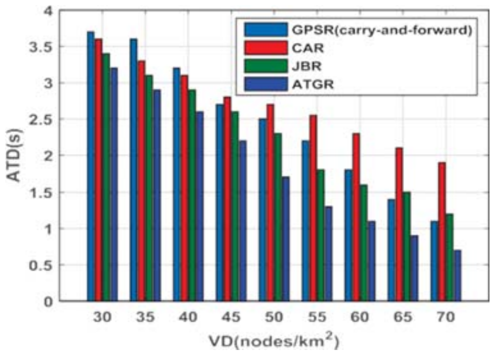

Fig7. ATD vs VD.

Tendency of increasing the PDR when the VD increases. This is because that the growth of VD results in an increase of the network connectivity, improving the opportunities of data packets to find the next hop. This will reduce the dropped data packets due to encountering link partitions. Besides, when the VD is increasing, data packets prefer to be forwarded wireless communication technology, which can further lower packet loss ratio incurred by the transmission timeout. As a result, the PDR of all the three protocols increases as the VD increases. Our proposed protocol ATGR achieves the best PDR compared with the other routing protocols.

The reason is ATGR can dynamically select the optimal next road segments at intersections, capturing the variety of vehicular traffic in real time. This is advantageous to deal with the rapid network topology changes. Besides, the best next road segment is determined based on the collected information connectivity and delay. When the density is sparse, the connectivity is the main consideration to make the route selection. In the tense situation, the transmission delay is the critical parameter to measure the network performance. This method can comprehensively balance the traffic status and channel quality. CAR only provides a routing path between the source node and the destination. Due to the lack of maintaining any backup routes, it is quite vulnerable in VANETs, resulting in higher PDR. As for JBR, it exhibits a lower PDR during the whole simulation. The collisions on MAC will increase with the growth of the VD, which make more data packets dropped because of not adequate signal-to-inference-and-noise ratio(SINR) at receivers.

Compared with other protocols, GPSRshows the worst performance. It finds the next hop only by one simple geographic progress. In this case, the sent packets may enter one road segment with the sparse environment, and the carry-and-forward scheme is employed to transmit the packets. Because of the incurred longer delivery delay, data packets are easily dropped before successfully reaching the destination.Fig.16 evaluates the OR of all the routing protocols when the VD is changing. It is noticed that the RO of CAR is decreasing as the VD is increasing. This is due to the use of an adaptive beaconing scheme with the aim to adapt tothe variation of traffic condition, where beacons are generated more frequently in low density situations than in high density scenarios.

For the other routing protocols, the increase of the PDR vs VD. Number of nodes leads to the growth in the RO, for the reason that the rate of control packets is proportional to the number of nodes. It is worth noticing that the RO depends on both the PDR and the size of control packets. Because of the lowest PDR, GPSR shows a higher RO. JBR uses the most control overhead in view of the destination flooding approach to provide query packets for the source node, thus incurring the higher RO. For our proposed protocol ATGR, the road segment weight evaluation needs to be executed to assign each road segment with an appropriate weight, which also will lead to an acceptable OR. In addition, considering the gains gotten in terms of ATD and PDR, this is a small cost.

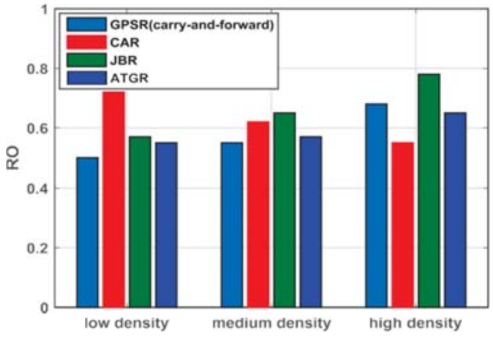

Fig 8.RO vs VD.

V. CONCLUSION

In this paper, an adaptive intersection-based transmission quality guaranteed geographic routing protocol. Each road segment is assigned with a weight based on the information collected related to connectivity and delay by road weight evaluation schemes. With the help of the weight information, the road segment can be dynamically selected one by one to comprise the best routing path, capturing the variation of vehicular traffic and reflecting the channel quality. When the packet is forwarded along the selected road segment, an improved greedy forwarding strategy is proposed to select the next hop, guaranteeing the fast and efficient data transmission. Simulation results show that our proposed protocol outperforms existing protocols in terms of packet delivery ratio and end-to-end delay.

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