International Journal of Computer & Information Technologies (IJOCIT)
www.ijocit.ir & www.ijocit.org
ISSN = 2345-3877

A Survey on Safe Data Delivery Methods in Vehicles Ad Hoc Network (VANET)

[1,2]Fereshteh Khedmati Yengejeh, [3]Shahram Jamali
[1] *Department of Computer engineering, Ardabil Science and Research Branch, Islamic Azad University, Ardabil, Iran*
[2] *Department of Computer engineering, Ardabil Branch, Islamic Azad University, Ardabil, Iran*
[3]*Computer networking lab, Department of Computer Engineering, University of Mohaghegh Ardabili, Ardabil, Iran.*
Email: fkhedmati@gmail.com

Abstract:- Vehicle network as one of the classes of ad hoc network was gained a significant improvement in driving safety on the road with an awareness of safety hazards on the road by providing one of the vehicle and roadside infrastructure. The safe and effective delivery of infrastructure to vehicle and between vehicles are the important factors that has become a research challenge. In this paper, some methods about effective data delivery on vehicle network had been investigated and compared. Effective data delivery include getting data from internet access points in roadside infrastructures like base stations, to moving vehicles on road section to satisfy user needed delivery rates and the rate of the loss of data and to minimize costs in terms of transport costs, overhead data, and data buffering. In this paper the results of the evaluation and comparison of investigated methods in aspect of crucial connection criteria are provided.

Keywords: Ad hoc, VANet, Safe data delivery, vehicle to vehicle communication.

1. Introduction

With the increasing proliferation of wireless communications, on an ongoing basis, we are witnessing the emergence of new types of wireless networks. Vehicle ad hoc network (VANET) is one of these new networks that is gradually has become typical in the field of wireless communications. It has received wide attention from industry and academy. Vehicle network is one of the classes of ad hoc network which contains wireless communications between vehicles nodes and access points to the internet. Since the vehicles are constantly moving and changing places, vehicle network should include dynamic configuration and quickly adapt to the changing positions of vehicles nodes. It also is difficult to maintain vehicle nodes with access points.

Recent research in intelligent transport system (ITS) in vehicle networks are focused on providing access to efficient internet for vehicle nodes by famous road side infrastructures as base stations. As an important part of the intelligent transport systems (ITS), vehicle network promises a wide range of valuable applications such as estimating real-time traffic for travel planning ,traffic monitoring, diagnosing of remote road conditions, timely dissemination of essential information including events, accidents, collapse of the pavement, measuring traffic lights, mobile access to the internet, and multimedia applications[1-3]. Especially for driving safety such as warning message delivery, VANET is faster and more reliable than mobile network (3G, 4G-LTE) with an additional delay due to the relay data via base stations, it also supports different road network services with cellular network. Cellular network service providers will spend significant costs for developing and maintaining of infrastructure due to this additional road network services [4].

These programs need to disseminate and spread information to part of vehicles in some areas. Receiver is dynamic and cannot be specified by the sender because the movement of vehicles is not clear. It is impossible to cover infrastructure signals of all areas which can be achieved by vehicle. Multimedia communications among vehicles are necessary for the destination or infrastructure. So package routing is remained challenging in such a network architecture that integrates communication v2v with communication v2I. However, vehicle move is restricted to the road. Although many mobile vehicles or smart-phones are equipped with GPS receivers, their movement may be restricted to predetermined routes. This is one of the VANET's features that make it possible to predict the movement of the vehicle [2].

Mobility management techniques help to support the TTS applications in VANET for awareness from stations vehicle location information update. For mobility management and awareness of vehicle location information, GPS technology is one of the tools that are widely used in this field to guide vehicles and the availability vehicle location information in every moment. It is expected that about 300 million units alone will have GPS by 2009. As well as a large number of manufactures have started installing the GPS receivers on the vehicles. Drivers with GPS -based navigation system are guided to select the best driving routes in the shortest physical route or low-way auto traffic congestion. So from the GPS-guided driving directions can be used to improve car network performance [5]. It is possible to get access the exact location of vehicles at the moment to the vehicle and convey a message to them.

For achieving the above plans, one of the important research topics is to design efficient data delivery methods. The efficient data delivery is to deliver data from access points to the internet in roadside infrastructures like base stations to moving vehicle in road sections that satisfy user required delivery rate and loss data rate and minimize costs in terms of transport costs, overhead data, and buffering data. In the next section, we examined and compared several initiatives addressed effectively data delivery.

The paper is organized as follows. In the second section we review and discuss the safe data delivery methods. Then, we compare reviewed methods in the third section. Finally, some conclusions are given in forth section.

2. Basic Concepts

VANETs are a special case of Mobile Ad Hoc Networks (MANETs), and consist of a number of vehicles traveling on roadways [6]. It is equipped with wireless and processing capabilities can create a spontaneous network while moving along roads. Direct wireless communication from vehicle to vehicle make it possible to exchange data even where there is no communication infrastructure, such as base stations of cellular phones or access points of wireless networks

The advances in mobile communications and the current trends in ad hoc networks allow different deployment architectures for vehicular networks in highways, urban and rural environments to support many applications with different QoS requirements. The goal of a VANET architecture is to allow the communication among nearby vehicles and between vehicles and fixed roadside equipments leading to the following three possibilities:

- *Vehicle-to-Vehicle (V2V) ad hoc network*: allows the direct vehicular communication without relying on a fixed infrastructure support and can be mainly employed for safety, security, and dissemination applications;

- *Vehicle-to-Infrastructure (V2I) network*: allows a vehicle to communicate with the roadside infrastructure mainly for information and data gathering applications;

- *Hybrid architecture*: combines both Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I). In this scenario, a vehicle can communicate with the roadside infrastructure either in a single hop or multi-hop fashion, depending on the distance, i.e., if it can or not access directly the roadside unit. It enables long distance connection to the Internet or to vehicles that are far away.

The purpose of safe data delivery is transmission data between vehicles safely and without loss of data. Forwarded data between the vehicles are information that must be transmitted over the road. In VANet data transferring is done through communication between vehicles. So, it's important to safe data delivery in this kind of network. In following sections, we investigate some safe data delivery methods.

3. Safe data delivery

In this article, we discuss about several safe data delivery in vehicle ad hoc network. In following sections, estimated dimension are described in detail and finally they will compare in the form of a table.

3.1. MMDD

In this article [1], handling management plan MMDD is proposed that helps base stations trace the location of registered vehicles for own services. Registered vehicles send their temporary updates to the respective base stations by distance- based or time-based mechanism. Consequently, leverage Location information to transfer data packets in an efficient and reliable manner is stronger. A paging mechanism is proposed through which the base stations can receive the latest location information from all registered vehicles.

In this paper, an urban environment is considered that is connected with intersections to each other. Communication is easy with and between vehicles by roadside infrastructure like base stations. Base stations are installed internet gateways at fixed points along the road. They can exchange information of wired connections with each other and the base stations. Since the vehicles are constantly changing their position, communication network is very dynamic in VANET and causes problems like frequent disconnection path. In this project, a local management system is suggested for effective data delivery (handling management) which helps to reduce the impact of these problems on the efficiency of communications. In particular. Its aim is to communicate effectively and reliably between base stations and vehicle in I2V. The plan includes four major process: advertising services, register, updates and data delivery.

3.1.1. Advertising services process

Advertising services process from the base stations arises to advertise their services throughout the network. This is done by periodic spreading of messages by radio waves within the range of base stations communication. As long as the urban road network is consists of numerous road crossing, radio waves can reach several times in several different paths to vehicles. Similarly, a vehicle can receive radio waves from several base stations by multicast with multiple hops. Messages that received from each base stations are a base station ID's which vehicles store ID's in table inside track. When the vehicle receives similar waves as if the vehicle is found another path to that station. After that, when sending packets from the vehicle to the base station, the car from this routing table, find the shortest path to the base station.

3.1.2. Register process

Vehicles start their registering process by sending register packages to one base stations. After that, updated vehicles send their information of the updated location to BS. Since vehicles receive their advertising services from several different BS, they should decide which BS needs to send message. In order to make this decision, vehicles use information of location by radio waves and send REGIST message to them.

Each REGIST contains movement information of vehicles including its location, speed and direction. After receiving REGIST, BSs record location information in a local data structure. This information is modified when location updated messages of vehicles are been received. As vehicles move across the network, they constantly change their location from one BS region to another. Following this move, if the new BS rout would be better, vehicle will send a REGIST message to new BS. Previous BS's ID is in register message So that the new BS could receive vehicle information from pervious BS according to connection on a wired network between the base stations. In summary, the registration process helps BS to keep track of movement of their registered vehicles for shared services.

3.1.3. The update process

BSs are able to communicate effectively, they need to have some knowledge about vehicle location at every moment. If there was active communication between the BS and a vehicle, vehicle location information can be tracked through data packages. However, in the absence of such an active communication, they should devise mechanisms so that BS are recent location information on all registered vehicles. For this purpose, vehicle can select respectively own BS for sending updated packages. Similar to REGIST, is update which contains vehicle information and location. There are two important ways in which vehicles can send their updates.

- **Time-based updates:** in this method, vehicles send their location information periodically to BS, as soon as a new REGIST be sent to a BS, vehicle sets an update timer. Each time the timer has been completed, vehicle sends UPDATE to current registered BS.

- **Location- based updates**: in this way, vehicles send their updated location to respective BS based on the distance they have traveled. Note that vehicles with different speeds may take place behind different amount of time between updates. This method is much more compatible to where it can be used both on highways with fast-moving vehicles and in urban environments with slow-moving vehicles.

3.1.4. Data delivery process

When a BS has data packages for sending to a vehicle in its service area, the vehicle information checks in a database. If there is the possibility of establishing an ongoing relationship with vehicle, so BS sends data package directly to vehicle. Otherwise, it acquires its current position through paging. BS send paging request to the target vehicle by geocasting, then vehicle replies with paging package that includes current location of vehicle. When BS receives the paging response, BS updates vehicle information in its amplitude database, and sends data package to vehicle.

3.2. MCNC

In this article[2], a multi- sectoral network coding method (MCNC) is designed to merges and publishes information in VANET. Data is divided to short fixed- size blocks in source vehicle and then spreads to other vehicles. Vehicles near access points performs network coding and send coded blocks to access points. Collected blocks again is coded among access points of multi-sectoral tree. Finally, blocks send to access points that anticipated target is close to it. This project that merges the process of information delivery network architecture V2V3 with communication of V2I is similar. At first, it sends data sources to infrastructure in multi connection among vehicles. Data is transmitted in the wired network formed by infrastructure then it be send from a number of infrastructure in multi-hop wireless communication. In MCNC method, three stages are defined: 1) to infrastructure 2) in infrastructure 3) to vehicles

To infrastructure stage: in this stage, messages are announced to the roadside infrastructure from the mobile sources which are moving vehicles. Dissemination of information is unreliable when information announce by resource that is far from infrastructure. So, information that is sent from close sources is reliable. Therefore, the connection between vehicles and infrastructures should be completed in a short time when vehicles are moving fast near infrastructures. Thus, at this stage, for each message is considered a life parameter t. In order to transfer unified data and realize network source coding operations, data is divided to several blocks with same sizes. Tmax is the maximum lifetime for each message. With producing blocks in source, t from Tmax counts down. When t is finished to a message that's mean t=0, indeed lifetime ends and other message is not active. So to avoid overloading the network should be thrown away.

At this stage, each vehicles have unique buffer. With receiving message they compare it with their own existing messages of own buffer. If the message be the same as received message, received message discarded. Otherwise, message will be buffer. Then, messages in buffer are investigated and the type of the message to be extracted. If an exciting message is an active message it will be checked to see life time is zero or not. If it be zero, it will be discarded. If the message be in one buffer, it will be coded and put at the disposal of router to find nearest infrastructure. If the existing message be in the form of code, it will be coded and will be send to nearest infrastructure.

- In Infrastructure Stage: infrastructures are connected by wired media. They are formed from wireless access points, servers, and so on. This is able to ensure reliability and data transmission in real time among infrastructures. At this scheme, we use multicast as link for data collection in infrastructure stage. Unique cast and general cast are considered as two types of specific multicast in this stage that's mean, all members of these group are all nodes or just one node.

When wireless access points are introduced as roadside infrastructures, they receives codded blocks from vehicles. These blocks are send to other nodes as its own destination. At this stage the tree is created for shared all access points that contain at least one network management server NMS as the root node. The root node is collecting blocks and coded them with regard to destination. Then it sends them to output access points along the tree.

Creating tree for multicast group is creating more sending phase in middle group that will cause delay in the data transition. NMS controls all calculation from shared trees. And maintains the link state database describing the topology of infrastructure. We collects all multicast groups of this stage in some shared trees.

There are one input router and some output routers in shared tree. Shared tree has one root node as network server and a leaf node as output access points. Network management server give one ID for each subset of the domain structure. It finds members of each multicast group according to the routing table from access points. All access points are divided to subsets and members of the all multicast group are clustered in subsets then, will select root and leaf of shared tree.

NMS selects root and leaf, then calculates topology of shared tree. All multicast groups indexed in G` and store its registers in network management server. Network management server unifies G` in terms of subsets ID. Number of G` with same ID are in traduced as C density parameter. If C be more than one specific alpha threshold, this group is integrated as one class group. There is one node and root for shared tree of each subset. This leaf is one input or output access point in each subset.

Access points send coded blocks of vehicles to multicast shared tree root with regard of the destination. Root overrides the same coded blocks and send stop message to coded vehicles. Then, root will coded again coded blocks with same sources and destinations. The coded blocks transfer to access points along multicast shared tree. Access points in tree cover areas that destination reached or will reach to them.

Re-coded blocks are sent to vehicles. Non-liner codes of available blocks in a same row for recoding with general coding matrix that is identified as F is selected. F matrix is unique and fixed in infrastructure and needs no transition to VANET. All vehicles have duplicate version of F and decode recoded blocks by using of F.

To vehicle stage: leaf in multicast tree is access points that may sends blocks to vehicle destination in defined period (Tmax). Their own Range communication cover location where vehicles pass or will pass. Blocks immediately are sent to access points after recoding. Lifetime is t=Tmax. Operation and calculation is like to infrastructure stage. Access points stop sending coded blocks of same row when they receive AKC message from vehicles then returns message to multicast tree root, access point also stops sending when a coded blocks are sent completely but done not return ACK message.

Vehicles buffer the blocks and sends when t=0. Vehicles return AKS message destination when they receive all decoded non-linear blocks from same rows, after that decoding starts.

3.3. PTDD

In this paper [3], one efficient data delivery method are proposed to helps public transportation that contain two stages. In first stage, one new method based on collecting destination information are provided to predict taxi driving directions. This method calculates effects of destination information in prediction process and thus improves forecast reliability and accuracy.

In second stage, one new data delivery named as PTDD are provided for improving data delivery operation in VANET which use efficiently from advantages of public transportation including forecast before driving route, long time moving on the road, no need for privacy.

3.3.1. Forecast driving directions to taxis

According to the Taxi operation law, the increase in passengers per day is the main way to increase revenue. Thus taxi drivers will always choose direction with shortest driving time to deliver passengers as soon as possible to their destination. Based on the collected information of destination from passengers, GPS device, electronic maps and traffic statistic information in different times, costs are as travel time average for each section of the road. One practical way is using Dijkstra algorithm for searching rout with lowest cost of current location to destination.

In order to improve the accuracy of forecasts, the features were used that are constant associated with the taxi drivers and familiarity with the road conditions and traffic. Through recording of drivers routing history and personal settings in different moments in each taxi, we can set anticipated rout to have consistent with real condition.

3.3.2. Feasibility and Practicality

There is no difficult technology and cost as one method to collect destination information for taxis because all technology is very reliable. The Problem is to create an incentive measures to cull their collecting activities. To solve the problem, the mechanism is necessary to create the proper account and sender or recipient must pay a fee to drivers to deliver the message fail.

When the vehicle can be accurately predicted and spread to neighboring vehicles greeting messages that the benefits to be estimated as follow: increased success rate of data delivery by forwarding messages to their destination with vehicles that will be determined rout driving by destination message. B) Increase the success rate for finding vehicles that move to anticipated desirable route in intersections c) debris mitigation wireless channel resources and thus reduce the likelihood if collisions wireless and improve channel quality which in turn can improve the delivered success rate.

3.3.3. Data Delivery Projects to Help Public Transport

By means of collecting destination according to forecasts provided driving directions, each taxi can know to advance their driving route. Thus, all means of public transport, including buses, trams, light rail, or taxi have similar characters that are awareness about their driving direction. According to this character, we proposed new data delivery plan named as PTDD in VANET.

Assuming each vehicle can reach to their pervious location by GPS, and access a digital point that has been installed at previous street level. Vehicles have connection with each other by short- range wireless network and can find their neighboring by using of optical messages such as lighthouse messages. Each optical message provide vehicle information such ID, location, speed, and direction, so each public transport will announce its driving path with optical messages.

Data delivery for usual public transport: in VANET, one vehicle for sending message needs three cases are as follows: a) the vehicle will produce its message b) the vehicle send those messages that receive from other vehicles c) it send messages periodically by getting buffer routing. When a normal vehicle (V) have message M for sending, at first, specific routing algorithm to select the optimal next hop vehicle runs from its neighboring list, and next vehicle will show as next hop, at the same moment vehicle is searching new vehicles that its driving rout will pass message destination. If more than one vehicle match, so it's the fastest average driving speed is selected. This vehicle recognized as adaptation with destination. Typical car after finishing query may be faced with the following:

- Both the two next hop and match-destination is to be found

Current Vehicle V send message M to next node, and then it creates a copy of the message named as M1, M1 copy flag increases and is sent to match- destination then vehicle V deletes the message M from its routing queue.

- only a next hop and match-destination is found or the next hop is equivalent to match-destination

V1 send message M to next hop and delets this message from its routing queue.

- none of the next hop and match-destination is found

this means V1 doesn't have next hop, it just puts the message into routing queue.

Data delivery for public transport. When a public transport pv1 has a message M, that pv1 itself passes from the destination or not. If pv1 doesn't pass, then the process of sending a message is similar to process of typical vehicles. Otherwise, pv1 send message M according to steps that are described below:

Step 1) in first step, pv1 is looking for a vehicle that pass from destination M. If no device found, then go to step 3; otherwise, pv1 continue to check if there are other vehicles that match. If so, after that vehicle is selected with the fastest average driving speed and this vehicle is identified as match-destination and go to step 2.

Step 2) current public transport pv1 runs routing algorithm and judges which one of the destination is better, if this is not go to step 3 , otherwise send message M to it and delete the message from routing queue and the process of sending message ends.

Step 3) vehicle pv1 runs routing algorithm for selecting next hop vehicle from neighboring list. Selected vehicle is shown as the next hop vehicle. If no hop found then pv1 put the message into routing line. Otherwise, current vehicle pv1 creates a copy of the message named as M1, M1 copy flag increases and is sent to next hop then M insert into routing line. The process of sending message ends.

When a message arrives from another vehicle, current vehicle checks to see if there is a copy of the message in the routing queue. If so, it picks the message directly from the queue otherwise, it puts message into queue.

Queue management algorithm. For any moving vehicle in VANET routing queue buffer size is limited. So Queue management algorithm has significant effect on performance of data delivery. The proposed PTDD, flag copy indicates that the number of copies reproduced and copy survival time shows how long a particular message is in the network. So copy flag and copy survival time together referred to the importance of the message. Queue management is based only on the two parameters. Messages are sorted according to increase their respective copy of messages. For messages with same copy flags, they are sorted according to increasing in copy survival time. So messages that have short flags or short survival time are close to queue and have higher priority for transition. Furthermore, messages will be removed in two positions: a) when a message arrives and the queue is full it is compared with the message in the end of the queue. Among them a message with a larger copy flag is removed or if the flag is equal copy of the message so the message is removed with longer survival time. B) when survival time of message is more than delay tolerant network , to avoid unnecessary occupation of a source, the message is removed.

3.4. TSF

In this article [4], a delivered plans named as trajectory-based statistic delivery TSF is proposed that is designed for providing data from under construction units(for example internet access points AP) to moving vehicles in vehicular network. This scheme is the first work in reviewing data reverse delivery based on trajectory by GPS-based navigation system. To ensure a closed meeting place and destination of a vehicle, the desirable goal as informational destination position packet in road network has been identified in order to minimize delay in data delivery while the probability needed package delivery of user is satisfied. The basic idea is to use two delay distribution In order to find such a desirable goal 1) package delivery delay distribution of AP to the point of interest 2) car trip delay distribution of the current position of the target vehicle- to- point destination. When target point was decided TSF ratified the source routing method for example, sending package by using shortest sending delay path by multiple intersection in the target road network.

Sending data from the vehicle to AP (fixed part) is done by using random models. Random model tries to send packages towards package destination by using next carrier in situ without fixed nodes at intersections. The effectiveness of random approach is mainly because the final destination is fixed in an access point. However, sending from AP to vehicle has different story. The high Data reverse sending rate successfully depends to accurate estimation because only depending on the time can be provided to a moving vehicle.

The goal of this scheme is package delivery from AP to destination vehicle with short delay. Delivery strategies are allowing to package to arrive earlier to the points. Since there is a fixed node in target point, reached earlier packages can wait for destination vehicle. Thus, one target point is identified as the meeting place point which package has high expectation to meet the target vehicle with the shortest package delay

Selecting the desired point is based on the likelihood of delivery in which package will arrive sooner than destination vehicle to desired point. This probability can be estimate with distribution of packet delivery delay and distribution of vehicle travel delay destination. If car traffic on road network is to achieve Poisson model. Distribution of packet delay and vehicle delay will be to follow a gamma distribution. Note that our model is not limited to Poisson model it also can accommodate any empirical model that is if the accurate distribution is available, the model can use it to calculate the probability of delivery.

Now delay link to a section of the road with one-way car traffic will be counted depending on the time between the arrival of the car, vehicle speed and range of communication.

Delay link to a section of the road are calculated with respect to two of the following for the fixed nodes at intersections.

Case 1) instant sending. There is at least one vehicle that moves to next intended intersection along packet sending way. Current packet carrier send own packets to fixed nodes in intersection I1. Fixed node packages is sent to vehicles that are in right path, and packages are sent to destination vehicle that this is done by sending interval. The ad hoc network connection consists of vehicles. Destination vehicle carries packages to fixed node of communication range that it is the transport distance.

Case 2) patience and transportation. There is no moving vehicle to next intended intersection along package sending road. Current packet carrier send own packets to fixed nodes in intersection I1 Fixed node packages store in local storing place I1I2 until one vehicle moves in road section. Average waiting time is $ that $ is vehicle arrival rate in the road sector i1i2.after that waiting average will continue to carry packages with transport distance including distance minus the waiting time.

Then, this scheme calculates end-to- end packet delay from one location to another in a given road network. According to the sending path of AP to target point, it is assumed that the delay edge link is composed of independent paths. From this assumption, mean and variance of packet delay E2E are calculated, respectively, as total average and total variances of delay link along the pathE2E.

Now vehicle delay is calculated from one location to another in given data road network. According to road network graph, travel time is modeled for every edge as gamma distribution. Note that we can gain distribution of travel time for every sector of the road by car traffic measurement that usually gamma distribution is considered. Gamma distribution parameters is calculated by the mean and variance of travel time.

For sending protocol TSF, TSF package contains two important areas:

a) Sending path

b) The trajectory of the vehicle.

Sending path is a list of intersections for source routing from AP to target point which it is sum of intersection in routing the target vehicle. By using this package TSF, data packages are send to destination of vehicle direction. Protocol is consisted of two phases:

- the first step is to send from AP to the target

The first step of sending is to send one package by source routing along sending path. Sending route is identified as shortest packet delay rout from AP to target. Fixed nodes in sending path are trying to send informational packets to moving carriers of the fixed nodes in its neighboring along path. So packet is given to the target point.

- the second step is to send from target to destination vehicle

The second step of sending is to send a packet by score routing along reversed routing from the trajectory of vehicle from target to destination vehicle. When fixed nodes package reach to target, it keeps fixed node package as long as one vehicle is passing. If vehicle go to the next intersection in the opposite direction, fixed node will send its package to the vehicle. Thus, package is sent to the reverse path of the trajectory of the vehicle's destination.

The logic of this reverse direction is to provide that optimization for an optimal target point with minimum of delay package delivery while required delivery is satisfied. This show that package will encounter with destination vehicle along trajectory of destination vehicle while will follow reverse trajectory vehicle package. Also, there are some probabilities that package reach to intended point after than destination vehicle. In this case, package wont encounter with destination vehicle so, after expiration TTL discarded.

3.5. TMA

This article [5], a trajectory- based multi anycast TMA is designed for efficient multicast data delivery in vehicular network in terms of transfer costs. This is the first attempt to check efficient multicast data delivery in vehicular network based on vehicle trajectory in multicast group.

This scheme is one road network with infrastructure nodes including traffic control center TCC, access point, and the relay node. Its aim is reliable package delivery from auto source AP to multicast group vehicle in end-to- end data delivery rate while shipping costs are minimized.

Traffic control center is reliable institution that maintains the trajectory of the vehicle without exposing the trajectory of the vehicle to other vehicles for privacy concerns. TTC specifies which AP multicast package will release for multicast group vehicles. Note that TTC and Aps connect to each other by wired network.

The relay node RN is one temporarily package holder for sending reliable package to package rout in target road network.

In this scheme it was justified vehicle network architecture including the relay node. Delivery delay variation in route package should be minimized in order to support on time data delivery of AP to destination vehicles. Otherwise, they will lose destination vehicle packages because they may reach to target points after destination vehicles. For minimizing Delivery delay variation, the relay nodes as storage node package and sending them to destination vehicle are deployed as long as destination vehicle passes from intersection. This model has a more accurate model of package delay rather than stochastic model. After on time delivery can be practical from AP to destination vehicle.

Also in this scheme multiple anycast concept is developed that include multicast to anycast collection where in anycast is collection of target points in auto multicast upcoming intersection of route of that vehicle.

Of these anycast sets some target points are selected then for these representative target points three type from deletion model in on time delivery like as the proposed models in TFS model are developed a) link delay model b) package delay model c) vehicle delay model.

After the calculation of these models by described distribution for TFS model, they began to build the multicast tree with minimum cost from AP to all multicast group vehicle, while ensuring given data delivery rate alpha. Optimal multicast tree is a minimum Steinler tree restricted delivery rate from package source AP to target points for all vehicle multicast group. Thus for one given multicast group M, we can identify multiple anycast as follow:

multiple anycast is sending package model from package source AP to multicast group M with minimum rate of multicast delivery so that for each any cast sets from Ai in vehicle multicast group M, its package AP spreads to one target point at in any cast sets.

Trajectory- based multiple any cast protocol supports in two phases:

- Unique spread of data and sending from vehicle source to AP for multicast data delivery. One vehicle send package resource of one close AP by source routed along the shortest path from the source to the AP using a scheme sent vehicle unicast.
- Unique spread of data and sending from AP to TCC: if AP receives one package from multicast group, it sends that package to TCC with information trajectory vehicles.
- Calculation of multicast tree for each package in TCC: TCC calculates limited multicast tree to delivery rate with vehicle trajectory from multicast vehicle group with regard to alpha package delivery.
- Unique spread of data and sending from TCC to AP: TCC sends package with multicast coding tree in in unique spread to AP. This AP is multicast tree roots.
- Sending multicast package to multicast tree: AP sends copies of the package to next relay (RNS) towards target point along multicast tree by decoding package.

- Storage and sending in RNS: copies of the package arrives to RNS related to destination node. RNS keeps destination vehicles in intersection to reach that RNS. When destination vehicle comes within range of communications of RN, copies of the package is sent to destination vehicle. Note that RN knew that when destination vehicle reaches by CTS/ RTS because one bench destination vehicle included in RTS or in CTS frames. With this approach CTS/RTS such as loss may cause to track traffic package when vehicles to a lot of destinations try to download packages from the same RN. In sum, all destination vehicle may not be able to download package when they pass RN coverage.

4. performance evaluation and comparison methods

In this part we discuss performance and methods to each other MMDD, MCNC, PTDD, and TMA. These methods attempt to improve the general criteria in data delivery questions in VANET. Examples of these measures include: data delivery delay , reducing the rate of loss of data, reducing the number of access points, increasing data delivery rate, reducing effects of vehicle speed on delivery rate, reducing delay with increasing numbers of vehicles, reducing communication overhead,

In this paper, we check and compare methods from the standpoint of the criteria. Results is shown in table 1.

Table 1. Comparison of reviewed methods in term of general criteria in data delivery in the VANET

	Reduce delay	Reduce missing packets	Reduce access points	Increase data delivery rate	Reduce vehicle speed effect on data delivery	Reduce delay with increase number of vehicles	Reduce communication overhead	Access to vehicle location method	Data delivery method
MMDD	⁕	⁕	-	⁕	-	-	-	Location Update	Paging
MCNC	⁕	⁕	⁕	⁕	-	-	⁕	Multihop Routing	Coding
PTDD	⁕	⁕	-	⁕	-	⁕	-	Path Prediction	Next Hop
TSF	⁕	-	-	⁕	⁕	⁕	-	Trajectory based	Reverse Forwarding

TMA	⁕	-	-	⁕	⁕	⁕	-	Trajectory based	Multi Anycast

5. Conclusion

In this paper, we reviewed five efficient data delivery projects in vehicle ad hoc networks. The first proposal was that MMDD is a switch management plan which helps base stations track the location of registered vehicles for its services and thus delivers data effectively to destination vehicles.

The second proposal was MCNC that was a multicast coding method for data integration and release in VANETs. Data transfer in MCNC is divided to three parts including network coding, multicast integration, and decoding.

The third proposal was PTDD that in first stage proposed one route driving prediction based on destination collection for taxies which in the initial phase of carrying passengers at any time can predict taxi driving directions. By taking advantage of these features, one new information delivery method is proposed by helping of public transportation.

The fourth proposal was TFS that was a delivered plan named sending statistic based on trajectory which is designed for presenting data from infrastructure nodes to moving vehicles in vehicle network. This paper is the first attempt to examine how to effectively use depending on trajectory of the target vehicles for such infrastructure delivered data to vehicle.

TMA is the latest designs that this paper sending based on multicast trajectory was designed and optimized for efficient multicast data delivery in vehicle network in terms of transfer costs. This was the first attempt to examine efficient multicast data delivery in car network based on trajectory of the vehicles in multicast group.

Examining Efficient data delivery plans in VANET due to evaluation and comparison have improved data delivery delay and data delivery rate. They are trying to improve the rate of data loss and reducing communication overhead.

References

[1] Boangoat Jarupan, Eylem Ekici, (2012),"Mobility management for efficient data delivery in infrastructure- to - vehicle networks", Computer Communications, Vol. 35, pp. 2274–2280.

[2] Lingzhi Li, Shukui Zhang, Yanqin Zhu, Zhe Yang. (2013), "MCNC: Data Aggregation and Dissemination in Vehicular Ad hoc Networks Using Multicast Network Coding", International Journal of Distributed Sensor Networks, Article ID 853014,11pages.

[3] Yong Feng, Ke Liu, Qian Qian, Feng Wang, Xiaodong Fu, (2012), " Public-Transportation-Assisted Data Delivery Scheme in Vehicular Delay Tolerant Networks", International Journal of

Distributed Sensor Networks, , Article ID 451504, 8pages.

[4] Jaehoon (Paul) Jeong, Tian He, David H.C. Du, (2013), "TMA: Trajectory-based Multi-Anycast forwarding for efficient multicast data delivery in vehicular networks", Computer Networks, Vol.57, pp.2549–2563.

[5] Jaehoon Jeong, Shuo Guo, Yu Gu, Tian He and David H.C. Du, (2010), "TSF: Trajectory-based Statistical Forwarding for Infrastructure-to-Vehicle Data Delivery in Vehicular Networks", IEEE International Conference on Distributed Computing Systems, pp.557-566.

[6] Felipe Cunha, Leandro Villas, Azzedine Boukerche, Guilherme Maia, Aline Viana, Raquel A.F. Mini, Antonio A.F. Loureiro, (2016), "Data Communication in VANETs: Survey, Applications and Challenges", *Ad Hoc Networks* doi: 10.1016/j.adhoc.2016.02.017