Volume 2, Issue 2
April 2013

ITEE Journal
Information Technology & Electrical Engineering

ISSN: - 2306-708X

Vehicular Adhoc Networks History And Future Development Arenas

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ABSTRACT

Nowadays, the world is in ones pocket in the form of tablet pc and other hand held devices. Now the main challenge in modern world is to provide mobility while remaining in the era of real time data communication. Currently lot of work is going on in this regard and the focus is on VANET. Vehicular ad-hoc network is technology which maintains vehicle to vehicle data communication as well as vehicle to network infrastructure communication. These two aspects of VANET make the modern day communication more efficient and effective. By establishing connection with an infrastructure user can use the internet and can communicate to the world while moving. On the other hand in vehicle to vehicle contact it can share certain data or situation with the other vehicle like information about road condition, accident and circumstances related to surroundings. Now this will make the decisions of other person autonomous in a sense that by getting the latest information from next vehicle the decision will be more intelligent that will avoid any abrupt situation. This will lead us to an intelligent system. The challenge in VANET is to provide a quality oriented internet service due to mobility. Because mobility introduces the concept of handoffs, which results in delay in throughput and frequent packet loss. This paper will focus on different handoff techniques and see which technique is best suited in providing the real time data communication for VANET.

Keywords: *VANETs, Handoff, Mobile Agent, IEEE 802.11p, v2V, V2I, Cross-layer design, Vehicular networks*

1. INTRODUCTION

The past few years the research work is going on mobile ad-hoc networks also called MANETS. Mobile ad-hoc network allow a mobile node to communicate in one to one and one to many nodes without any predefined infrastructure.[1]

The required protocols to support MANET are more complex as compared to other non-mobile networks because due to mobility there is no predefined infrastructure or topology of MANET. VANET is a unique type of network which comes under the umbrella of MANET. VANET has some predefined basics which includes (1) Predictable mobility of vehicles because movement is in two directions only (2) The transmission mode is often broadcast (3) The power available is sufficient [2]. There are two communication modes which are vehicle to vehicle and vehicle to network infrastructure.(see figure-1)

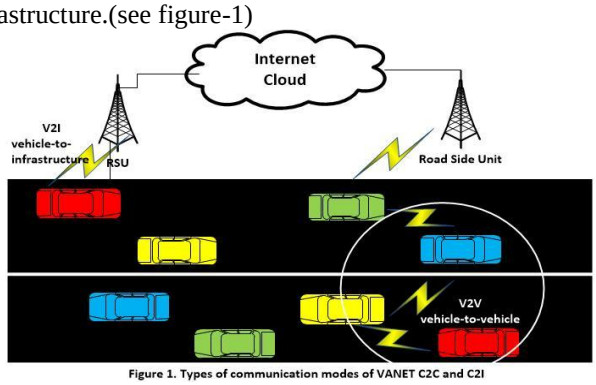

Figure 1. Types of communication modes of VANET C2C and C2I

The main need of VANET is to provide an efficient network where vehicles can communicate and share real time data. The VANET application are usually classified into two categories which are safety –oriented applications and value added applications.

Value added applications which are part of vehicle to network communication mode need nonstop connection to facilitate the user. To accomplish this task by using IP addressing the mobile IPv4 was proposed in 2002 [3]. But due to some limitations in IPv4 like deficiency of IP addresses and security forced the introduction and need of mobile IPv6 in 2004 [4]. MIPv6 is only suitable at micro level mobile environment. To encounter the particular problem the hierarchical mobile IPv6 was introduced in 2005 [5]. HMIPv6 introduces mobility anchor point MAP. Mobile host having micro level mobility establishes a link care of address (LCOA) and after this inform its MAP with the help of messages. To facilitate macro level mobility the mobile host establishes a regional care of address (RCOA) and then inform to the home agent. LCOA is consist of MAC address of mobile host and prefix of access router. On the other hand RCOA consist of MAC address of mobile host and prefix of MAP.

Now the above stated solutions and addressing schemes only solve the problems of terminal mobility but to solve the network mobility problem a protocol named NEMO was proposed in 2005 [7]. The protocol uses a cluster of MH's that are in a vehicle or moving in a group will utilize the network bandwidth with the help of dedicated host which is called mobile router MR. The MR will allot care of address (COA) to all hosts with the help of DHCP. When MR moves to new AR its COA will be updated. Now MR will update about its COA to its HA. The HA will send packets to the group which are hosted by that particular MR.

The above all discussion has showed that there are many mobility management protocols which are introduced to facilitate the nonstop internet connection but handoffs in VANET are still a strong challenge to this purpose. Handoffs are major source of throughput delay and significant packet loss. In the above portion we have literature review of protocols in this regard.

The rest of this paper is organized as follows. Section II describes the necessary procedures involved in a VANET handoff process. Section III surveys the related studies in the literature, and Section IV concludes this paper.

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2. VANET HANDOFF PROCESS

A handoff cannot be performed suddenly. There are different decisions which are to be made internal to the system. When handoff is initiated there are several steps which are performed at different layers.

The steps which are performed at data link layer (L2) are trigger, discovery, authentication and association. The steps which are performed at network layer (L3) are IP address acquisition and home agent registration.

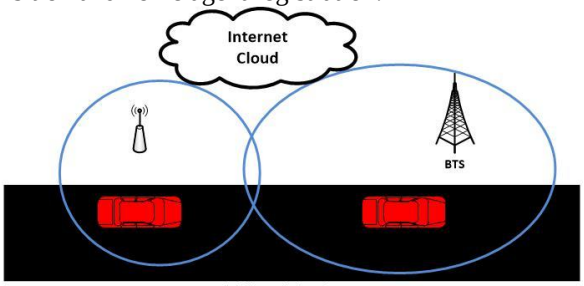

Figure 2. Handoff from shifting from WIFI to GPRS

2.1 Trigger

It is performed at layer 2. The distance between mobile and access point is detected with the received signal strength at the mobile device. When the distance is increased so much that the received signal strength at the mobile drops below a certain threshold value then this trigger happens and MH will try to establish connection with new access point with better RSSI.

2.2 Discovery

We are still at layer 2. In this step MH sends probe packets to find new access point or listens through periodic packets broadcast by different AP's. In wireless communication there are two different scanning modes which are termed as active and passive scan [6]. In active scan mode a mobile device sends packets which are also called probe packets on a certain channel. It then waits for a specific time slot which is called Minimum channel time to get the response. In case of no response the mobile will send probe packets on another channel to find the response of nearest AP. In passive scanning mode mobile will not send any packets but it will only listen to the broadcast messages sent by the access points and then establish connection with access point having best RSSI value.

2.3 Authentication

Authentication is also done at data link layer. This includes the security assurance that only a legal user should have access to the system. There are two modes of authentication which are Open system authentication and share key authentication. By default the first mode is active. In share key, privacy algorithms are used. In share key authentication encryption and decryption are also implemented.

2.4 Association

Last step which is performed at data link layer is when mobile device sends request to AP to associate with the new access point. The access point will complete the process of association and the send response to the mobile device. In case where mobile device switch from one access point to another then association request will be comprises of information about old access point.

2.5 IP ADDRESS Acquisition

Now the network layer contribution starts which are purely IP based. When mobile device moves into another AR's coverage area, an advertisement will be sent to the mobile from the new AR which are always periodically broadcast by the routers. Mobile can also ask for this notification by sending the request. These messages consist of prefix and interface identifier so that particular COAs can be generated. The duplicate address detection technique should be adopted to make sure that the address is not already in use. This procedure takes more time and also contributes to an overhead [7]. This detection process is a drawback for handoff process in VANET [8].

2.6 Home Agent

Now mobile device will inform about its new CoA with the help of update messages to home agent. Home agent will send acknowledgement to the mobile device.

3. REVIEW OF RELATED STUDIES

This paper [10] demonstrates diverse strategies of vertical handoff decision which are centralized, distributed and reliable distributed. The constraints are throughput, Decision time and node to node delay. The paper contribution is that it authenticates that among above stated strategies, reliable distributed technique has better results in favor of handoff decision with inadequacy of large delay in decision time and node to node data transfer. Also there are some judgments involved in deciding the target network to avoid congestion.

The paper [11] introduces new unified algorithm for handover in real-time data transfer with profligate authentication. The result analysis is done on the basis of signaling cost and packet loss. The results are in favor of proposed algorithm with appropriate quality and security in providing services as compared to IMS, MIPv6, FMIPv6. This technique also decreases the amount of authentication notifications which in result minimize the latency in the network. Also the chances of packet loss are also reduced. Paper inadequacy is that it is sensitive to packet loss and in case it happens then it will lead to loss of synchronization and to counter this a new security association or roll back to previous state is required.

The paper [12] has introduced a design for cohesive heterogeneous network to increase and efficiently manage the vertical handoff, exploiting unique resource query scheme for Media Independent Handover. Strength of this method is that it minimizes the signaling, configuration time, power utilization, authentication time, handover delay but also making sure that quality and security is not compromised. The Inadequacy of the paper is least authenticity of its work.

This paper [13] introduces an enhance version of SIP for vertical handover to reduce delay and then comparing it with original SIP. The strong point of this version is that it uses make before break handover and effectively defined two new headers in the existing SIP for supporting delay sensitive applications in real time and also have compatibility with the existing networks. The Inadequacy of this paper is that it neglects the effect of latency on layer 2 and 3 and also the increased header size affects.

The paper [15] describes an authentication method between GSM, UMTS, WIFI and WIMAX technologies by neglecting any prior contribution to the network. The strong point of the paper is that the authentication method used is globally

ITEE Journal
Information Technology & Electrical Engineering

ISSN: - 2306-708X

applicable for handover in 4G networks and also showed its strength to manage the services effectively in handover scenario. The inadequacy of this technique is that it compromises the quality and also only suitable for mesh topology networks.

The paper [16] illuminates on layer to layer analysis of vertical handover on layer 2 and layer 3 signaling to connect different WIMAX and 3g networks. The strong points of the paper is that it first distinguishes the layer2 and layer3 packets and combining them into a frame results in reducing latency and packet loss and upgrading the effective throughput. The inadequacy of the work is that it considers only predictive fast handover scenario which is very much susceptible to failure.

The paper [21] has proposed a vertical handover decision algorithm which is based on probability of avoidance of ping-pong effect. The strong points of the proposed algorithm are that it evaluates the decision probability by releasing of terminated and useless vertical handovers results in enabling the mobile terminal for the execution and avoidance of vertical handover. This scheme is also called mobile terminal controlled handover. Inadequacy of the scheme is that it did not consider other estimations of through put and analysis of similarity at distinct interims.

To improve the triggering process, discovery process and association process the following author's proposed different techniques.

According to [12] currently used protocols of IEEE 802.11 are not performing to facilitate the handoff scenario in modern day high speed transport vehicles. There are some complications which includes the delay that occurs due to channel look over and relaxed process of association with the newly found access point with better RSSI. Some solutions are also provided to overcome these drawbacks. First we have to apply limitation on no of channels to be scanned. Secondly we have to perform some functions on the mobile side (1) to monitor the RSSI levels of different access points in limited time. (2) Making connection with access point having high RSSI from the monitored access points. (3) Adopting data rate overcome the frequent and hasty variation in RSSI level.

The author in [14] has referred vehicular high speed communication is possible by using IEEE 802.16j protocol version for mobile multi-hop relay. The solution propose in [14] is fast handoff for vehicles. According to [14] relay vehicles can be implemented by using public transport vehicles. A relay vehicle has the responsibility of managing mobility to provide seamless service to other vehicles in their surroundings. Relay vehicles will transmit the data packet of other vehicles to the internet. Multi-hop relay system is best as vehicles moving in same direction have analogous speed.

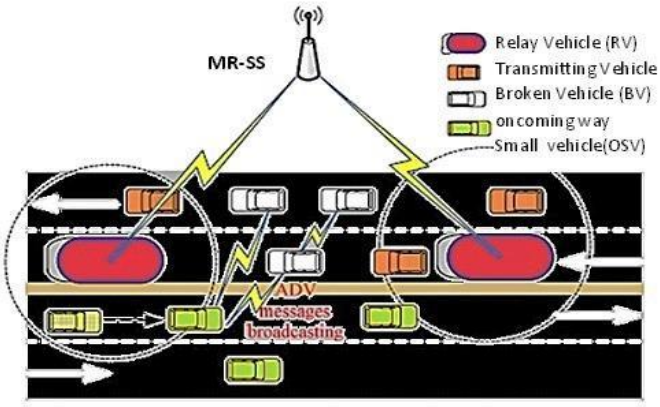

Fig.3 displays the design of fast vehicular handoff system. The design shows that a vehicle which is broken can access the system with information broadcast by approaching small vehicles. An ASV is responsible for retrieving physical data of an RV. Main purpose of design is that ASV broadcasts the network information to broken vehicles by using predefined frequencies. When disconnected vehicles approach towards an RV they access the information with specific frequency channel. Ultimately it will reduce the latency.

The study in [18] defined that vehicles should have more than one LAN interface capabilities. An interface should have its dedicated antenna. So the purpose of more than one antenna is that the data transmission and receiving will be performed by an antenna. While , second antenna will be used for scanning the connection with new access point. If RSSI of an access point is better than the existing one, then antenna will perform functions of registration and authentication. Now the other antenna will work as transceiver. Now the use of two antennas will improve the possibility of smooth handoff and time will also be reduced.

To make the authentication fast In [17], Pack et al., proposed a method to reduce the handoff latency experienced by authentication. Their method is to request the authentication data of the neighboring APs from the AAA server (authentication, authorization, and accounting) before execution of handoff process.

To improve the process to acquire the IP address the author in [19] has studied and showed that in rapid vehicle movement the connection time is about 25 seconds. DHCP takes 2 to 3 seconds to provide the IP address. Based on this study the author in [20] has introduced IP passing scheme. The idea is that when a vehicle will leave the area of an access point it will leave a IP passing packet. When a vehicle will enter it will listen the passing IP packet and take that IP address otherwise from DHCP.

To improve the **Fast HA Registration** the author in [9] has introduced virtual-bus concept by combining NEMO and multi-hop relay systems.

In this structure MR has the responsibility of connecting all devices in bus to internet. HA will manage and track all this. A bus will be having two MR's at front and back. MR is connected to internet using WIMAX technology and devices will use WIFI to access MR. Front MR will be used only for handoff management and back MR is actually giving services to all the devices. Virtual bus is concept which includes group of vehicles instead of a single bus. First and last vehicle in that

group will act as front and back MR. This study was carried out on different sizes of virtual bus to monitor the performance and quality.

4. CONCLUSIONS

In this paper, we review the essential processes tangled in a VANET handoff process. We also appraisal the fast handoff schemes suggested in the literature to improve the diverse procedures involved in the handoff process. Till to date, there is not sufficient work done on the fast handoff for VANET. To improve the handoff process the combination of different fast handoff approaches vestiges an open research issue and needs more investigation.

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