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Fast Handover Algorithm for Mobility Management in VANETs

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Abstract: VANET is different from MANET due to high mobility of nodes and large scale networks. VANET is a form of network that provide vehicle to vehicle and vehicle to infrastructure communication. The main gaol of VANET is to provide the road safety .Various wireless communication technologies used for VANET, the IEEE 802.11p is to support the medium range communication characteristics of vehicular environments. One of the main issues of VANET is handover process. It can be effectively achieved through Fast Handover for IEEE 802.11p (FHP) mechanisms and it is based on vehicle to infrastructure communications. FHP is proposed for efficient data transmission that takes place high mobility of vehicles and continuous topology change. The performance evaluation and simulation results show that the scheme can minimize the handover latency and packet loss.

Keywords: VANET, Handover, IEEE82.11p,FHP, latency, packet loss

1. INTRODUCTION

A Vehicular Ad Hoc Network (VANET) uses cars as mobile nodes in a MANET to create a mobile network. VANET are estimated to be key supporting technology for the delivery of wide range of services. VANET turns every participating vehicle into a wireless router or node, around covers a distance of 100 to 300 meters of each other to connect and create a network with a wide range. Thus communications arepossible between vehicle to vehicle(V2V) and from vehicle to infrastructure (V2I) [1].This V2I based communication take place through RSU. In a VANET environment this devices are stations(STAs) fixed in vehicles as On Board Unit(OBU) or access points(Aps) located in fixed points along the road ,and usually denoted to as road side units(RSU).

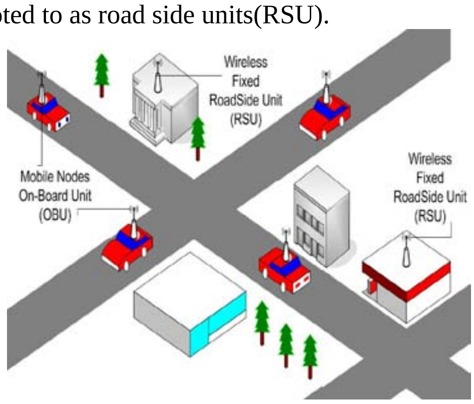

Figure1.Vehicular Ad-hoc Network

V2V is based on dedicated short range communication and V2I is mainly based on GPRS,Wifior WiMAX. VANETs are considered as a hopeful technology to support safety related applications[2], which enables moving vehicles or nodes to collect real-time road traffic information accurately and notify neighboring vehicles of potential dangerous events quickly and identifying the next RSU. The whole communication between vehicles takes place through the 802.11p standard[3]. But the range of this 802.11p is very low and distance up to 300 m is limited.The wireless communication technologies have been proposed for VANET, IEEE 802.11P is operate with the WAVE (Wireless Access in Vehicular Environments) [4] system. To adapt to the characteristics of vehicular networks such as high mobility, IEEE 802.11p has changed some parameters of the physical layer and Medium Access Control (MAC) layer of 802.11p [5]. At the physical level, IEEE 802.11p defines seven Service Channels (SCH) and one Control Channel (CCH).CCH is dedicated for the transport of messages from the network management and mobility control, while SCH is intended for data exchange. All the OBU and RSU use 10MHz bandwidth and operate band in 5.9GHz band. Data transmission rate ranges is from 3 to 27Mbps depending on the modulation scheme. The range is increased to 500 meters(1000 meters of diameter).

2. RELATED WORK

Many existing solutions and research works try to study and optimize the handover IEEE802.11p mechanism while try to minimize latency and packet loss. We will present some different approaches to develop this mechanism Choi et al. was suggested a novel seamless handover SHW. This handover utilizes the IEEE802.11 disassociation message to signal the old RSU that an OBU will depart its coverage zone, so that, the data frames can be forwarded to the new RSU for delivery to the OBU. The disadvantage of this mechanism is specified at the buffer size and the limited number of retransmissions for the new RSU Prakash et al. developed an approach called CSHSbased on V2V communication for two mechanisms obtaining information of the next RSU from a combination of vehicles of other target areas. The OBU received packets intended to it from a vehicle candidate, in the same area, during the handover period. In this approach, collisions can be made due to the high number of exchanged messages between vehicle .Leo et al proposed a scheme for mobility based handover in VANETs for Global management in Vehicle to vehicle and Vehicle to Infrastructure environment. This proposed scheme manages the local ID of VANETS, permanent address and Mac address of vehicles. This is used for preparing fast handover process using L2 trigging and route optimization.These schemes better than other existing schemes in terms of delay and latency Zhu et al. states the various mobility models of vehicular networks. Here mobility models are identified on the basis types of communication occur in VANET's i.e. V2V and V2I. Various schemes are stated for both these communication and comparison of these schemes is also done. To manage mobility in vehicular networks the requirement of vehicles on the basis of communication types are also identified. Host and network based mobility is also described in this paper.J.M Chung et al. propose a management priority mechanism WHC based on V21 communication. Each RSUincludes an ordered list of MAC addresses of its OBUs. These addresses are listed on the basis of emergency OBUs. The OBUs approaching the limit of the zone are ordered first and have priority access over other channels. Thisapproach minimizes the handover delay and congestion in the channel CCH but introduces high losses packets in case of a high speed vehicle.

3. PROBLEM DISCRIPTION

To design and implement the FHP in VANET IEEE802.11p mechanism has support the short distance and it is not suitable in non-sight conditions. Also demand for efficient data transmission and packet loss and latency is a key challenge. Because of high mobility in vehicles the topology also changes very frequently and there is need of handover so that vehicle can move to another network without any interruption[6].The handover problems IEEE 802.11p mechanism is due to listening of WAVE Service Announcement (WSA) [7]. This mechanism has some limitations like collisions, packet loss, latency, When the OBU receives two or more WSA frames,at that time it must choose which one will join RSU. After receiving the first WSA frame from the new RSU, the OBU sends a message to the old RSU to retrieve all packets. In this case number of packets will be lost because the retransmission limit and the high mobility of vehicle.So we propose a FHP method to improving the performance of handover IEEE802.11p standard mechanism[8].

4. PROPOSED SCHEME

Handover mechanism for IEEE802.11p has in order to limit the problems caused by listening to the WSA frame, we propose a FHP algorithm, this new approach involves the anticipation of the handover phase while implementing and improvements to this standard mechanism[9].

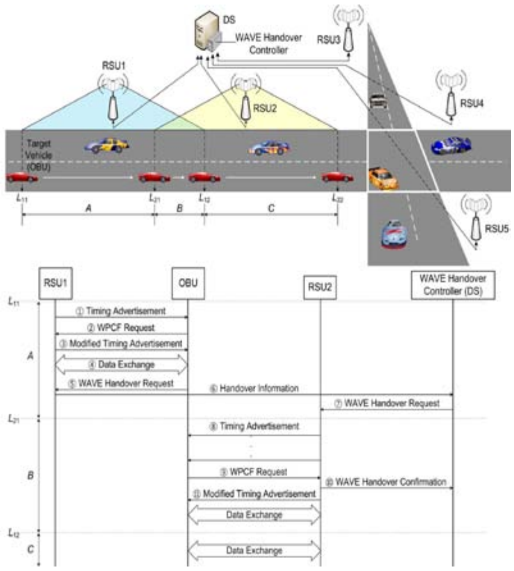

Figure 2.Handover procedure and corresponding message

Figure 2 shows an example of the proposed handover scheme in VANET environment, the RSUs are deployed alongside the road and connected to a distribution system (DS) which is equipped with the proposed WAVE handover controller (WHC).WHC controls handover between the RSUs.The range of communication for RSU1 is from locations L11 to L12 and for RSU2 it is from locations L21 to L22. The location and time at which a vehicle enters the service area of RSU1 are L11 respectively.

FHP approach includes the following four steps:

- OBU is before start the handover phase first determine the next RSU.
- Optimize the recovery mechanism of the packets from the old RSU.
- Priority management mechanism.
- Handover phase.

4.1. Determination of the next RSU of the OBU

When the vehicles are determining next RSU, the current RSU launches the procedure for determining the next RSU to the OBU. While sending a request to the WHC who in turn sent to entity controller network determine the list of candidates RSUs. WHC sorts the list according to criteria: vehicle speed, destination vehicle and type of involved handover. WHC determines a new CoA (Care of Address) and adds it in the information of the new RSU. Finally, WHC sends this information to the current RSU which builds a context message containing allthe information to join the new RSU.

4.2. Packet recovery mechanism from the old RSU

In order to limit the problems caused by the standard mechanism for retrieving packets from the old RSU, we propose some improvements to overcome the issues. Just before the start of handover, when the OBU sending packet to the new RSU the current RSU stops transmitting packets and transmitted them to the new RSU. After receiving the first WSA frame from the new RSU, the OBU can start receiving these packets. With this mechanism, it accelerates the transmission of packets to the OBU.

4.3. Management priority

We develop a mechanism to management priority in FHP. In addition, the RSU creates a list containing the identifiers of all OBUs part of its transmission area. In this case, the OBUs which are located in new RSU will be placed first in this list.Therefore, all messages exchanged in FHP by theseOBUs, have high priorities to be transmitted in the channels.

4.4. Handover phase

It describes the operations performed by the OBU during the handover phase.The OBU extract the information for the new RSU contained in the message context and construct a request message WRM (Wave Request Message) and sends them to the new RSU. This request aims to accelerate the sending of the first WSA. In case of network-level handover, the OBUsends a Binding Update (BU) to HA. With this mechanism, we can minimize the handover delay due to waiting for the first WSA frame and the configuration of the new CoA
address.

5. PERFARMANCE EVALUATION

The main aspects that will allow us to detect an improvement in terms of handover performance are the packet loss, and overall handover latency and ratio for dropped/sent packets. NS-2 simulator with version 2.34 was used to evaluate the performance of proposed handover[10].

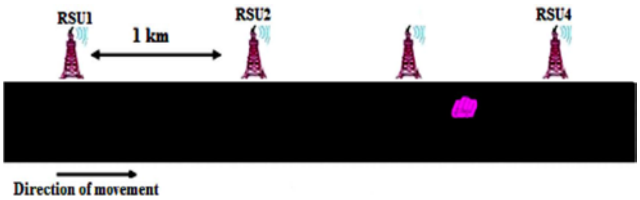

Figure 3.Highway area

Table 1. Mobility parameter

Parameter	Value
Road length	5 km
Map area	1km
Map area	5kmx1km
Number of RSU	6
Number of OBUs	30
Distance between 2 RSUs	1km
Vehicle speed	100~160km/h

6. SIMULATION RESULTS

The proposed scheme is compared, in term of handoff delay and the percentage packets loss, with the standard mechanism of handover IEEE802.11p[11]. Our proposed method delivers best performance.

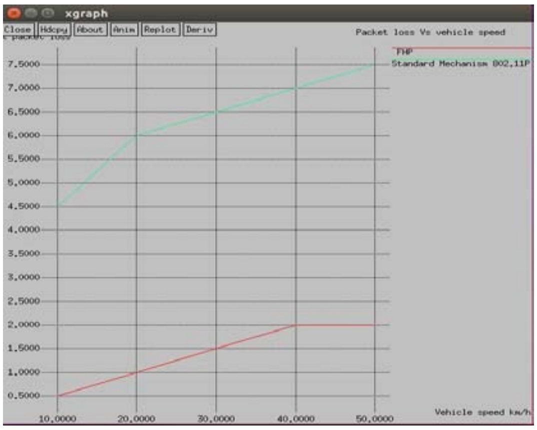

Figure 4.Packet lossVs Vehicle Speed

Figure 4, shows the fast handover algorithm provide less packet loss compared to standard mechanism. FHP achieved the OBU has enough time to connect with road side unit but standard mechanism not have enough time to receive WSA frame. So the handover delay is increased.

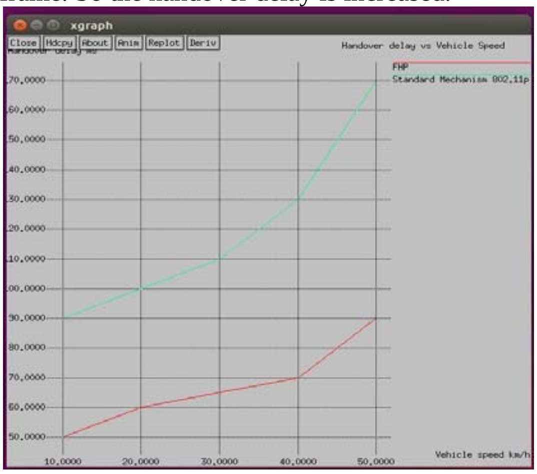

Figure5.Handover delay Vs vehicle speed

The above NS-2 graph display the handover delay compared to standard mechanism, FHP provides good delay for a very high mobility. This is due to the mechanism of determination of the new RSU. In addition, the OBU has sufficient time to configure it with this RSU to connection configuration mechanism that accelerates the sending of the first WSA frame. FHP uses efficient paths, when sending these packets, while eliminating the congested nodes[12]. The standard mechanism suffers more congestion when compared the FHP.

7. CONCLUSION

For good and better data communication in vehicular ad hoc network a better handover mechanism play an important role in the process between the vehicular communications. In this paper, we proposed on novel fast handover for the IEEE802.11p based system. Our scheme takes advantage of this by making the OBU inform the old RSU before an any connection break that proactive actions can be initiated to prevent frame losses even before its link establishment with the new RSU. The performance metrics measured for the proposed work using NS2 with version 2.34 simulations has been showed greatly reduce the latency and packet loss in FHP method.

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