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Improving Performance Level of Traffic Channel, Mobility Conditions Based On VANETs Clustering and Modelling

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ABSTRACT - *In Vehicular Ad Hoc Networks (VANETs), vehicles driving along highways can be grouped into clusters to facilitate communication. The design of the clusters has significant impacts on communication quality. Such design is affected by the Media Access Control (MAC) operations at the Data Link layer, the wireless channel conditions at the Physical layer, and the mobility of the vehicles. Previous works investigated these effects separately. In this paper, we propose a comprehensive analysis that integrates the three important factors into one model. Closed-form expressions of network performance measures, such as packet loss probability and system throughput, are derived. Our model, validated by extensive simulations, is able to accurately characterize VANET performance. Our analysis reveals intrinsic dependencies between cluster size, vehicle speed, traffic demand, and window size, as well as their impacts on the overall throughput and packet loss of the cluster. Performance evaluation results demonstrate the practical value of the proposed model in providing guidelines for VANET design and management.*

***Keywords*—VANET, medium access control, Markov chain, Road Side Unit, mobility, On Board Unit**

1. INTRODUCTION

Vehicular Ad hoc Networks (VANETs) are the promising approach to provide safety and other applications to the drivers as well as passengers. It becomes a key component of the intelligent transport system. A lot of works have been done towards it but security in VANET got less attention. Now days, the sheer volume of road traffic affects the safety and efficiency of traffic environment. Approx. 1.2 million people are killed each year on the road accidents. Road traffic safety has been the challenging issue in traffic management. One possible way is to provide the traffic information to the vehicles so that they can use them to analyze the traffic environment. It can be achieved by exchanging the information of traffic environment among vehicles. All the vehicles are mobile in nature, hence a mobile network is needed which can be self-organized and capable of operating without infrastructure support. With the progress of microelectronics, it becomes possible to integrate node and network device into single unit and wireless interconnection, i.e. ad hoc network. Further this network is evolved as mobile ad hoc network.

VANET is an application of mobile ad hoc network. More precisely a VANET is self-organized network that can be formed by connecting vehicle aiming to improve driving safety and traffic management with internet access by drivers and programmers. Two types of communication are provided in the VANET. First a pure wireless ad hoc network where vehicle to vehicle without any support of infrastructure. Second is communication between the road side units (RSU), a fixed infrastructure, and vehicle. Each node in VANET is equipped with two types of unit i.e. On Board Unit and Application Unit (AU). OBU has the communicational capability whereas AU executes the program making OBUs communicational capabilities. An RSU can be attached to the infrastructure network which is connected to the Internet.

2. SCOPE OF THE PROJECT

The scope of the project **VANET Modeling and clustering** is to support Critical vehicular safety applications, such as emergency warning, collision avoidance, and road condition broadcast and lane-changing assistance in an efficient manner by improving the performance level, overall throughput and packet loss of the cluster.

2.1 DEDICATED SHORT RANGE COMMUNICATION (DSRC)

- Challenges in VANET:
- Changing topology due to mobile nodes

  Routing / Broadcasting with reliability

  Avoid collisions

- Critical response time for alerts

  Sparse or Dense traffic

  No prior control messages

- Security

Integrity and Authenticity

- VANET Active Safety of Passengers and more reliable.802.11p Add wireless access to vehicular networks and implements OSI stack. Wireless Protocol with Licensed band of 5.9GHz, 7 channels, Range of 1000m, Data rate 6 to 27Mbps.
- Mainly used in communication of

  1) Vehicle to Vehicle

  2) Vehicle to Roadside

- Scheduler in every OBU
- Pre-emptive policy for Higher Priority Messages
- Each OBU has a valid certificate issued by CA (Certification Authority) based on unique license plate registration. Based on Digital signature sent by OBU, using Public key decryption message is verified.

3. SYSTEM ANALYSIS

EXISTING SYSTEM

In empirical path loss models were developed in four different vehicle-to-vehicle environments, i.e., highway, rural, urban and suburban. In analysis of one-dimensional, an analytical model was proposed to investigate the connectivity of VANETs in the presence of Rayleigh, Rician and Weibull channels, from a queuing theoretic perspective. In one-hop broadcasting, analytical models were developed for broadcast efficiency and reliability in 802.11p for Rayleigh fading channels. In evaluation information propagation, the connectivity of information propagation was studied, focusing on packet loss rate, packet transmission distance and effective coverage range of road-side stations.

4. RELATED WORK

In this section, we provide background and related work on VANET clustering.

4.1 Related Work on VANET Clustering

The IEEE has specified 802.11p as the MAC and PHY standard for data exchange between high-speed vehicles and between vehicles and roadside infrastructures in the

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licensed ITS band of 5.9 GHz (5.85-5.925 GHz).At MAC layer, data are transmitted using broadcast, which is a subset of the IEEE 802.11 standard distributed coordination function (DCF) . As a result, most existing VANET Markov models are extensions from the general DCF models and proposed a Markov model for the throughput of the enhanced distributed channel access (EDCA) mechanism in the IEEE 802.11p MAC sub layer under saturated traffic conditions.one-dimensional Markov model for analyzing the performance of periodic broadcast in VANETs was proposed, where traffic conditions are unsaturated. These VANET Markov models assume ideal channel conditions, which are not always true in mobile vehicular environment. Empirical path loss models were developed in four diff erent vehicle-to-vehicle environments, i.e., highway, rural, urban and suburban. An analytical model was proposed to investigate the connectivity of VANETs in the presence of Rayleigh, Rician and Weibull channels; from a queuing theoretic perspective. The connectivity of information propagation was studied, focusing on packet loss rate, packet transmission distance and eff ective coverage range of road-side stations. Studies have also been carried out on the aspect of the moving patterns in VANETs. Luan et al. characterized IEEE 802.11 Distributed Coordinated Function (DCF) with vehicle velocity and moving directions in highly mobile vehicular networks.

5 PROPOSED VANET MODEL

In this section, we propose a new VANET cluster model which integrates the three important aspects of MAC protocol operations, PHY channel conditions, and the moving pattern of the vehicles.

5.1 PHY Decoding Failure Wireless

PHY channel conditions can have strong influence on the system packet loss, even in collision-free cases. Even if capacity-achieving codes are employed at the transmitter, there is still a finite probability of packet error due to a channel outage effect. The channel outage effect refers to the fact that the current encoding rate is higher than the actual channel capacity. In this paper, we derive the packet error probability based on the outage probability of the vehicular channels, as this provides the lower bound of the packet error probability under an assumption of ideal coding and modulation. Fast fading effects are taken into account by incorporating a so-called block fading model. Specifically, a packet is divided into Lp blocks (or coherence periods). The channel coefficient remains constant over the lth coherence period (i = 1, · · · , Lp) and is i.i.d. across different coherence periods.

5.2 MARKOV CHAIN MODEL

Consider the low-bandwidth traffic nature of emergency, safety related, messages. We introduce a new idle state, where the buffer of a member vehicle is empty. In this case, we can establish a Markov chain model extended from the Liu‘s 3-DMarkov model. We note that in WLAN and VANET environments, the carrier sensing range is substantially larger than the communication range. This is because much lower receiver sensitivity is required to carry out energy detection than it is to detect actual information data.

Given a cluster of vehicles that are within the communication range of each other, they must also be within each other‘s carrier sensing range. The vehicles are able to carry out CSMA/CA back off correctly. To this end, the effect of fading channels is negligible within a cluster, as far as MAC is concerned.

5.3 Inter-Cluster Communication

Message propagation direction is very important when designing the protocol architecture. Safety messages are mostly propagated backward (against vehicles' motions) at most of the time, while no safety data is mostly exchanged in both directions. Our protocol serves both types of traffic such that, safety messages are delivered to neighbor clusters on the CCH, and the non-safety data is delivered on the SCHs. The basic components of protocol operation are as follows: • Bidirectional communication via all SCH and CCH is supported between neighbor clusters • CHs receive and relay safety messages backward via CCH, and distribute them locally to all CMs via SCHs. • CHs are allowed to use CCH to send safety messages backward, and advertisements in all directions. • Cluster synchronization is only performed by the clusters in the back. They constantly try to adjust their system cycles to match the starting time of the cluster in the front.

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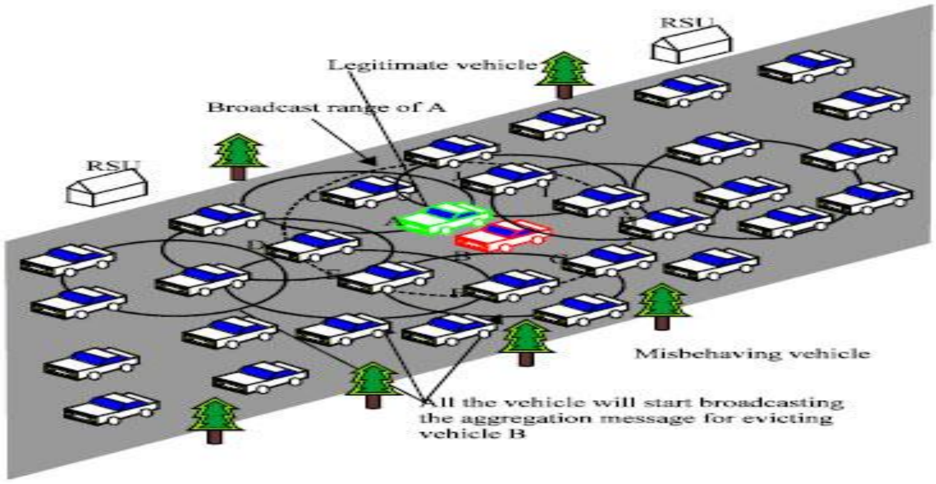

Fig 1. **System Architecture**

6 CONCULSION AND FUTUREWORK

In this paper, we proposed a new analytical model for the performance analysis and clustering design in VANETs. Our model integrates MAC protocol operations, PHY layer wireless channel conditions, and the moving pattern of the vehicles. We also derived closed-form expressions for average packet loss probability and throughput of a VANET cluster. Validated by extensive simulations, our model represents a new approach for the performance study of VANET. In particular, we derived system measures that quantify the effects of cluster design criteria on VANET performance. Such measures can be used to determine the suitable cluster size, typical network span, and adequate data traffic control to achieve the desired system reliability and network throughput. The proposed model and analysis provided guidelines for the design and management of VANETs to maintain acceptable communication performance.

In our future work, we are going to extend our cluster model to adaptive data rates and multiple clusters, and incorporate inter-cluster routing, channel allocation, and interference management.

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