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Neighbor Discovery and Routing Protocol for Vehicular Ad-Hoc Network: Survey and Discussion

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ABSTRACT
Vehicular Ad Hoc Network (VANET) classified as one of the most important classes of next generation networks that developed in recent years rapidly for vehicles and road transmissions. It can help in implementing a large set of applications related to vehicles, traffic light, traffic jam, drivers, passengers, ambulance, police, fire trucks and even pedestrians. Routing is the most prominent problem in the transmission of information in VANETs and there are many modes of dissemination: unicast, broadcast, multicast and geocast. In this paper we present the literature survey for the vehicular ad-hoc network for the road safety application and improve the performance of intelligent transportation system.

Keywords:. Vehicular Ad Hoc Network, Dedicated Short Range Communication, Intelligent Transportation System, Mobile Ad Hoc Network, Quality of Services.

INTRODUCTION

Several societal and technological trends underpin the rapid development of VANETs (Vehicular Ad Hoc Networks) [1]. On the one hand, there is an increase in vehicle ownership, especially in the developing world, and on the other hand, there is a technological maturity in both intelligent transportation and automated driving. VANETs are multi-hop systems that create temporary associations between mobile vehicle entities. The associated vehicles exchange information by wireless communication technology such as IEEE 802.11 and DSRC (Dedicated Short Range Communication). Currently, lots of research has focused on dealing with the frequent change of vehicle network topology and the rapid movement of nodes in VANETs, with the aim to improve the communication performance between vehicles. Whilst, VANET inherits the general features from MANET (Mobile Ad Hoc Network), the rapid mobility of vehicles also generates a fast changing network topology and limits the link connection time. For any two nodes that are out of each other's communication range, their communication has to go through a number of intermediate nodes via multi-hop connections. Particular application environments, such as: narrow roads, high density distribution of vehicles, or high-speed mobile vehicles, will directly affect the transmission performance of network information which includes the packet loss rate, end-to-end delay, network load and so on. This is further exasperated by the fading and shadowing properties of wireless channels. Therefore, the traditional transport layer protocols or routing protocols such as AODV, DSR, and OLSR in MAMANET, may lead to high packet loss or long end-to-end delay.

Exchange of information between vehicles can be either V2V or vehicle-to-roadside (V2R) and creating VANETS for the former has some advantages as compared with doing so for the latter. First, a V2V-based VANET is more flexible and independent of the roadside conditions, which is particularly attractive for most developing countries or remote rural areas where the roadside infrastructures are not necessarily available. Also, these VANETs can avoid the fast fading, short connectivity time, high frequent hand-offs, and so forth, caused by the high relative-speed difference between fast-moving vehicles and the stationary base stations. However, the link qualities in V2V communications can be very bad due to multi-path fading, shadowing, and Doppler shifts caused by the high mobility of vehicles. Nevertheless, V2V communication used as the basic means of communication between vehicles and roadside units may help in places of high vehicle density [2].

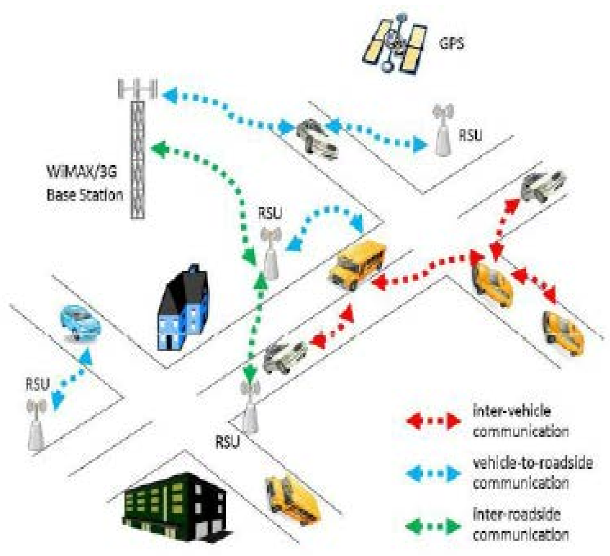

Figure 1: VANET architecture.

Different applications have different requirements. For instance, time-sensitive data such as safety and emergency messages should have guaranteed minimum delay while bandwidth-hungry applications have throughput requirements. Furthermore, different protocols are appropriate for different environments which make the choice of the right protocol along with the knowledge of its characteristics in the context of QoS, important. Real-time applications demand high throughput, whereas safety messages require high reliability. In VANETS, maintaining a certain threshold of QoS is easier said than done. For instance, connectivity QoS requirement which is an important parameter in VANETs due to the frequent inherent disconnections between communications links of the vehicles. This happens due to highly dynamic topology and speed of the vehicles. The trade-off comes between coverage and interference. By increasing the coverage area (or vehicles using full available transmission power) increases the interference and vice versa. Thus, determining the minimum transmission range of vehicles is critical [4].

VANETs can support a number of applications, namely infotainment, safety, etc. Currently, there is a need to support vehicular communication for applications such as safety messaging, traffic and congestion monitoring and Internet access. One of the most promising application of VANETs are safety applications. Approaching emergency-vehicle warning, post-crash warning, accident reporting, blind merge warning, and pre-crash sensing, among others, are effective applications for improving road safety. Safety applications usually rely on broadcast-based protocols. These protocols have the task of disseminating emergence messages quickly and efficiently through the network. Hence, a key research problem here is how to design a scalable information dissemination method that can efficiently work with high reliability and short delay under different network conditions [6].

The rest of this paper is organized as follows in the first section we describe an introduction of about the Vehicular ad-hoc network and their application. In section II we discuss about the Machine to machine communication in network, In section III we discuss about the rich literature survey, finally in section IV we conclude the about our paper.

II MACHINE COOMUNICATION

The machine type communication device (MTCD) is installed on every vehicle. The vehicles can access the eNodeB at their designated time slots. In return, the eNodeB offers resource blocks (RB). Thus RB can either be busy or idle represented by the set {0, 1} following a Poisson distribution. The transmission rate of MTCD is shown as a function of signal-to-interference ratio and bandwidth by Shannon’s theorem. The hypervisor is set up for the virtualization of the network. It also enables the scheduling of the resources. The vehicles with similar functions are included in the virtual network. Vehicles cannot observe the state of the RBs directly. Thus to deal with this problem partially observable Markov Chain tool is observed. The MTCD can observe RB, take action or make a decision from the history of the observation system. For correct RB selection, the maximum transmission rate is offered by the RB as a reward. The proposed tool for solving the problem offers a higher transmission rate as compared to present schemes and random selection method.

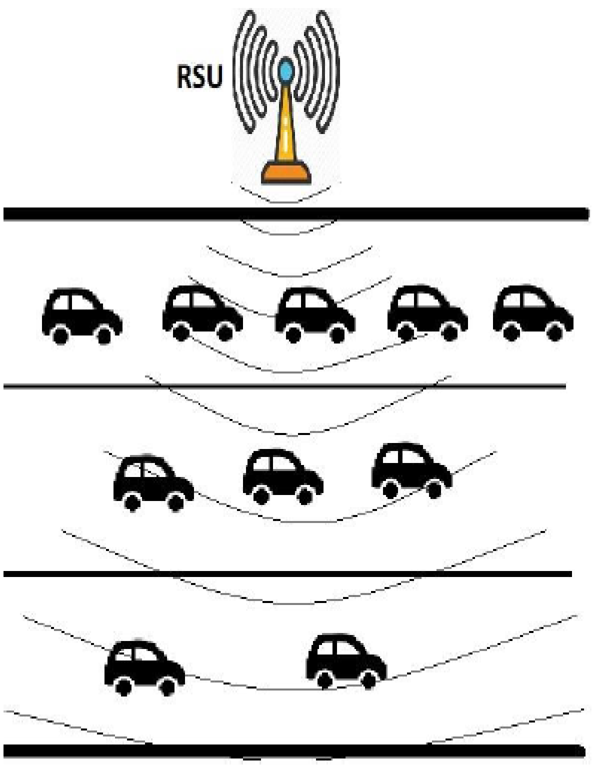

Figure 2: RSU providing coverage to the vehicles along the road

III RELATED WORK

[1] In this paper, they proposed a new algorithm for quickly discovering neighbor node in such a dynamic environment. The proposed rapid discovery algorithm is based on a novel mobility prediction model using Kalman filter theory, where each vehicular node has a prediction model to predict its own and its neighbors' mobility. This is achieved by considering the nodes' temporal and spatial movement features. The prediction algorithm is reinforced with threshold triggered location broadcast messages, which will update the prediction model parameters, and improve the efficiency of neighbor discovery algorithm. Through extensive simulations, the accuracy, robustness, and efficiency properties of their proposed algorithm are demonstrated. Compared with other methods of neighbor discovery frequently used in HP-AODV, ARH and ROMSG.

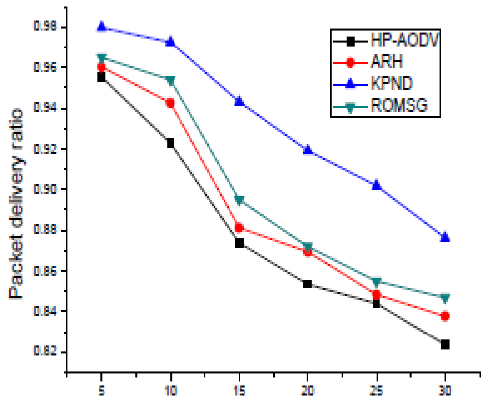

Figure 3: Packet delivery ratio [1].

[2] The proposed social clustering techniques have been compared with the Low Id, Dynamic Doppler Value Clustering and MPBC clustering methods. The first is a typical topology-agnostic clustering method, and the other two are high-performance mobility-based techniques that use relative speeds of nodes in order to create clusters. The obtained simulation results have demonstrated the greater effectiveness of SPC and RSC when compared to their competitors in terms of cluster stability and cluster size. Further work includes the aggregation of social patterns of vehicles and the use of different sub channels for each social group of vehicles in order to improve the performance of the clustering methods. [3] In this paper they propose a predictive handover utilizing a movement prediction method to conduct the costly handover ahead of time, thus providing a consistent IP connection. The approach is tested and compared in a variety of simulated vehicle

network environments. Results show an overall improvement in network performance with handover latency greatly reduced. The central performance issue is the minimum requirements of a mobile IP handover setting a performance ceiling that FMIP and HMIP methods have not resolved. Both do not initiate until transition to the next AP is detected, which makes completion of the required handover steps before performance deterioration difficult to ensure.

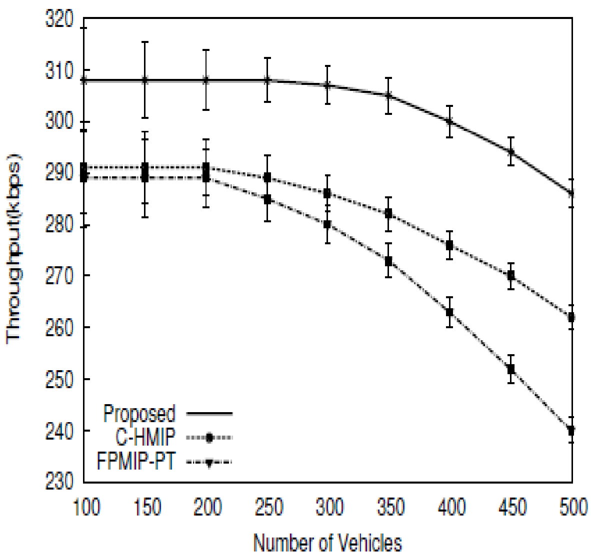

Figure 4: Throughput versus vehicle densities [3].

[4] They presented the importance of QoS in VANETs for different applications and scenarios. They discussed the various approaches adopted by different authors to ensure guaranteed services in VANETs. They also discussed present VANET protocols in the light of QoS and defined their applications. The paper also reviews the different approaches and protocols. The open research issues that need to be addressed for improving the performance of routing protocols for VANETs are discussed. [5] This paper follows the guidelines of systematic literature reviews to provide a premier and unbiased survey of the existing prediction-based protocols and develop novel taxonomies of those protocols based on their main prediction applications and objectives. A discussion on each category of both taxonomies is presented, with a focus on the requirements, constrains, and challenges. Moreover, usage analysis and performance comparisons are investigated in order to derive the suitability of each prediction objective to the various applications. Also, the relevant challenges and open research areas are identified to guide the potential new directions of prediction-based research in VANETs. [6] This work lays out a decentralized stochastic solution for the data dissemination problem through two game-theoretical mechanisms. Given the non-stationarity induced by a highly dynamic topology, diverse network densities, and intermittent connectivity, a solution for the formulated game requires an adaptive procedure able to exploit the environment changes. Extensive simulations reveal that our proposal excels in terms of number of transmissions, lower end-to-end delay and reduced overhead while maintaining high delivery ratio, compared to other proposals. [7] They have proposed two cluster-based algorithms for target tracking in VANETs in our previous works. These algorithms provide a reliable and stable platform for tracking a vehicle based on its visual features. In this paper, they have demonstrate performance evaluation and testing results of both our algorithms in the context of vehicular tracking under various scenarios. They have also compared the performance of both our algorithms to assess the performance of distributed algorithms as compared to centralized cluster based target tracking algorithms. Besides, they have tested two data dissemination techniques for information delivery. Performance evaluation results demonstrate clearly that the proposed clustering schemes provide better performance for target tracking applications as compared to other cluster based algorithms.

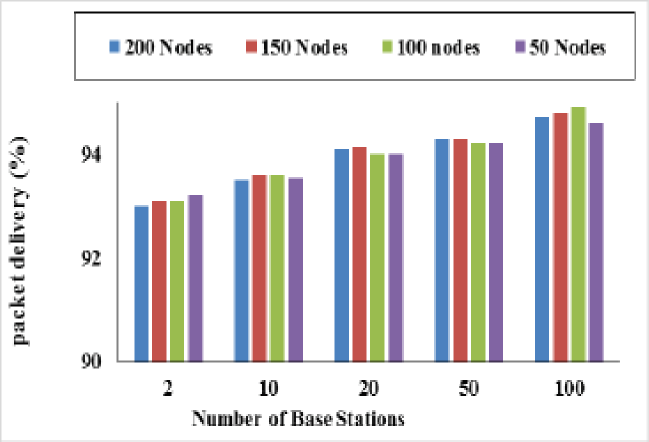

Figure 5: Packet Delivery Ratio of Multi-Hop Routing Method under Different Number of Nodes and Base Stations.

[8] In this paper, they investigate how to achieve dependable content distribution in device to device (D2D)-based cooperative vehicular networks by combining big data-based vehicle trajectory prediction with coalition formation game-based resource allocation. First, vehicle trajectory is predicted based on global positioning system and geographic information system data, which is critical for finding reliable and long-lasting vehicle connections. Then, the determination of content distribution groups with different lifetimes is formulated as a coalition formation game. They model the utility function based on the minimization of average network delay, which is transferable to the individual payoff of each coalition member according to its contribution.
[9] In this article, they proposed on demand Misbehavior Detection technique for vehicle-to-vehicle communication. They adapt two location-based routing protocols, Contention-Based Forwarding and Connectionless Approach for Streets, to their On-demand Misbehavior Detection. Various experiments are conducted to show the effectiveness and efficiency of the proposed On-demand Misbehavior Detection technique. The simulation and analytical results showed that the proposed technique is very effective in detecting misbehaving nodes. [10] In this paper they have surveyed those applications briefly and have proposed an alternate taxonomy for classifying existing DTN routing algorithms. The objective of this survey is to help future researchers to identify DTN specific properties in the new applications and to apply appropriate routing protocols whenever necessary. They have studied the relation between message replication and individual or group communication semantics of DTN routing protocols considering both social-based and opportunistic message forwarding techniques. They have also introduced an in-depth coverage of data dissemination protocols in DTN which can be adapted to content-centric networking domains.

V CONCLUSIONS

Due to the highly dynamic topology of VANETs, modeling and predicting the vehicle mobility could play a key role in designing efficient communication protocols. Fortunately, the movements of the vehicles are usually constrained along roads and streets. Therefore, the future movements of the vehicles are predictable. In this paper, a literature review of prediction-based protocols for VANETs is presented with reference to their application, prediction objective, and performance metrics.

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