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SURVEY ARTICLE

Survey Paper on VANET-Based Traffic Information Sharing

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Abstract— In order to improve information propagation efficiency, there are couples of ways there to obtain near about accurate information to maintain the traffic. In low density areas, buses collect as much traffic information as possible from cars in their proximity, and periodically disseminate the collected information to neighboring cars. Another way is Information dissemination in pure Vehicular Ad Hoc NETworks (VANETs) such as ITS-G5 becomes problematic when the network is sparse. There are couple of more ways which can help out to reduce or maintain the traffic problem.

Keywords— VANET; Traffic; V2V Communication; ITS (intelligent Traffic System)

I. INTRODUCTION

In vehicular networks, vehicles equipped with wireless communication technology can communicate with each other. However, the wireless technology used in vehicular networks has a limited communication range. Therefore, if the density of vehicles equipped with this technology is too low, information dissemination has poor quality, or in the worst case does not function at all. The reason for this, is that the network becomes fragmented, resulting in disconnected clusters of vehicles due to the limited communication range. Therefore, information dissemination beyond these clusters is impossible or leads to massive delays. If information dissemination fails, the applications that rely on information from other vehicles also fail. Therefore, it is important that the performance of information dissemination is reliable so safety applications are functional.

The main reasons for a low density of equipped vehicles are traffic density and market penetration. Of course a low traffic density implies a low density of equipped vehicles. Rural areas often have smaller roads with low traffic density. Also, during night time less people are traveling causing a low traffic density. The market penetration is another reason of low density of equipped vehicles, because in the early years of market introduction only a small portion will be equipped with this communication technology.

"VANETs are considered as one of the ad hoc network real-life application enabling communications among nearby vehicles as well as between vehicles and nearby fixed equipment, usually described as roadside equipment."

Vehicles can be either private, belonging to individuals or private companies, or public transportation means (e.g., buses and public service vehicles such as police cars). Fixed equipment can belong to the government or private network operators or service providers. Indeed, vehicular networks are promising in allowing diverse communication services to drivers and passengers. These networks are attracting considerable attention from the research community as well as the automotive industry. High interest for these networks is also shown from governmental authorities and standardization organizations.

A. C2C-CC reference architecture

A reference architecture for vehicular networks is proposed within the C2C-CC, distinguishing between three domains:in-vehicle, ad hoc, and infrastructure domain settings. The in-vehicle domain refers to a local network inside each vehicle logically composed of two types of units: (i) an on-board unit (OBU) and (ii) one or more application unit(s) (AUs). An OBU is a device in the vehicle having communication capabilities (wireless and/or wired), while an AU is a device executing a single or a set of applications while making use of the OBU's communication capabilities. Indeed, an AU can be an integrated part of a vehicle and be permanently connected to an OBU. It can also be a portable device such as a laptop or PDA that can dynamically attach to (and detach from) an OBU. The AU and OBU are usually connected with wired connection, while wireless connection is possible.

This distinction between AU and OBU is logical, and they can also reside in a single physical unit. The ad hoc domain is a network composed of vehicles equipped with OBUs and road side units (RSUs) that are stationary along the road. OBUs of different vehicles form a mobile ad hoc network (MANET), where an OBU is equipped with communication devices, including at least a short range wireless communication device dedicated for road safety. OBUs and RSUs can be seen as nodes of an ad hoc network, respectively, mobile and static nodes. An RSU can be attached to an infrastructure network, which in turn can be connected to the Internet. RSUs can also communicate to each other directly or via multi hop, and their primary role is the improvement of road safety, by executing special applications and by sending, receiving, or forwarding data in the ad hoc domain. Two types of infrastructure domain access exist: RSU and hot spot. RSUs may allow OBUs to access the infrastructure, and consequently to be connected to the Internet. OBUs may also communicate with Internet via public, commercial, or private hot spots (Wi-Fi hot spots). In the absence of RSUs and hot spots, OBUs can utilize communication capabilities of cellular radio networks (GSM, GPRS, IMTS, WiMAX, and 4G) if they are integrated in OBU.

Regarding the c2c c-c reference architecture together with the advances in heterogeneous communication technologies, vehicular network potentially have two main types of communication scenarios: Regarding the C2C-CC reference architecture together with the advances in heterogeneous communication technologies, vehicular networks potentially have two main types of communication scenarios: car-to-car (C2C) communication scenario and carto-infrastructure (C2I) communication scenario.

II. MESSAGE FERRYING [1]

The message ferrying technique aims to achieve efficient data propagation in disconnected ad hoc networks. In ad hoc networks, communications are often unstable due to the limitation of wireless range and node mobility. The ferry relays messages between nodes which cannot communicate directly. In this technique, all nodes are classified into regular nodes and message ferries. Here, regular nodes move freely, but ferries move regularly along the predetermined routes. Regular nodes send messages to ferries or receive messages from ferries. Ferries collect messages from regular nodes, move to other disconnected portion of ad hoc networks, and send the collected messages there.

III.SCENARIO AND SIMULATION SETUP[2]

In this work we focus on the behavior of ITS-G5 in sparse VANETs and investigate the benefit of adding an additional communication link, in this case a satellite link. The scenario consists of a rural road topology, an area with low traffic density. We assume th at road hazards can be identified by drivers or on-board vehicle sensors. The information about the road hazard is compiled into a Road Hazard Warning (RHW). This application uses DENMs to inform other vehicles about this imminent danger ahead (DENMs are mainly used by the RHW application). It is of utmost importance that the dissemination of the RHW is reliable and in time. If a vehicle receives the warning too late, or does not receive the message at all, the safety application will fail, and the vehicle could possibly run into an accident. Therefore, our most important evaluation metric is the In Time Reception of the RHW. The evaluation of this metric is done by comparing the braking distance of a vehicle to the current distance to the hazardous location at the point it receives a RHW. If the braking distance is smaller than or equal to the distance to the hazardous location, it is assumed that the vehicle received the RHW in time. The approach is exemplified. The braking distance of the vehicle is given by

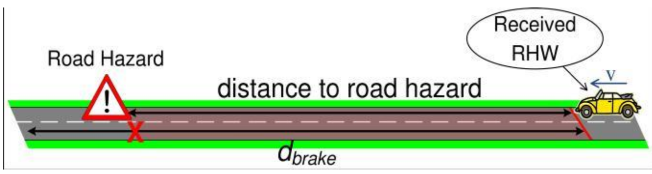

Fig 1. Breaking Distance

Evaluation of the In Time Reception of the RHW. In this example, the RHW is not received in time, since the braking distance dbrake is larger than the distance to the hazardous location, indicated by the warning triangle. The velocity v of the vehicle is used in the calculation of the braking distance.

dbrake = v2

2 _ b

+ _treaction _ v

which is calculated by its velocity v at that point and deceleration b. We assume a deceleration of 5 m=s2, comparable to deceleration on wet asphalt. The delay _treaction represents the popular human reaction time of one second. To have a realistic scenario we use OpenStreetMap as a source to generate the road topology for our simulation. For this, the area "Obere Donau" is chosen, a 20_20km rural area south of Stuttgart, Germany. The generation of traffic is based on the assumption that the inter-arrival time of vehicles can be modeled by an exponential distribution if traffic density is low, i.e. less than 1000 veh=h. Vehicles are generated on the edges of the road topology.

Using the exponential distribution, we generate traffic according to the average traffic volume for the L218 (the center road of the area) given by road traffic census of the province Baden-W¨urttemberg 2005, of what the "Obere Donau" is part of. For the L218, the traffic volume during day time is approximately 155 vehicles per hour. The traffic simulation is done by using SUMO, an open source microscopic road traffic simulation software.

The communication between the vehicles is simulated with the open source discrete-event network simulator ns-3. The ns-3 mobility model is fed by the SUMO generated trace to simulate the movement of our realistic traffic scenario. For the communication model we assume no access control and no collisions in our implementation, to reduce complexity of the communication simulation. This simplification is indeed justified because of a sparse VANET scenario. Distilled road topology from Open Street Map, as used by SUMO with the original map in the background. The red circle indicates the place of the road hazard, located at the L218.

IV. ROUTING TECHNIQUE IN DTNS [3]

As mentioned in, DTNs are often described with various phrases, such as eventual, partially, intermittently or transient connected networks, opportunistic networking, and space-time routing. All aforementioned terminologies are used to describe a network where end-to-end connectivity is not assumed and communication is affected with disruptions and delays as a result of network disconnections and partitions. The best example of DTNs is MANETs since nodes in such networks are usually moving and network structure is constantly changing. To overcome all mentioned shortcomings, efficient routing protocols are required. As described in, based on network time-evolving topology they can be categorized as routing protocols for deterministic or stochastic time evolving networks. If all future topologies of the network are completely known or predictable then deterministic routing can be applied. There are three different approaches: (i) Space time routing; (ii) Tree approach; and (iii) Modified shortest path approach. They are all based on modeling the dynamics of the network as a space-time graph or tree and then selecting the final path depending on requirements (shortest time or minimum number of hops). In dynamic networks, where network behavior is random, future network topology is unknown and cannot be predictable. Therefore, to deliver packets from source to destination routing protocols for stochastic time-evolving networks should be applied. There are five different approaches:

A. *Epidemic routing-based approach:* The classic example is to flood the message through the network. However, this approach is very costly and can cause network congestion. Another example is to deliver message only when source and destination are within communication range. Although this approach has minimal overhead, the delay is often very long. The best results are obtained with approaches that are trade-off between these two extreme examples. Another example is spray routing. The idea is to first unicast sprayed packet to a node close to destination and afterwards multicast traffic within the vicinity of the last-known location of the destination. Furthermore, by adding relay nodes between source and destination routing performances can be significantly improved.
B. *History or predication-based approach:* In this approach the link forwarding probability is estimated based on the one-hop or end-to-end information. Nodes can interrogate each other to learn more about network topology and nodal capacity to make intelligent routing decisions. One-hop information is usually obtained by exchanging the information between two nodes when they meet. The selection of the next hop can be based on the various metrics, such as: spatial location, bandwidth, relative velocity/mobility between two nodes, and vicinity of the candidate, capability of the candidate and data transmission time.
C. *Model based approach:* It is based on modeling motion patterns of mobile nodes for a better selection of relaying nodes and a determination of receiver's location without flooding the network. For example, in VANETs, the two mostly used vehicle traffic models are: highways and city traffic models.

D. *Node movement control-based approach:* Controlling node mobility can improve overall system performance. There are different ways to control node mobility such as modifying nodes trajectories, using virtual mobile nodes that travel through the network and collect and deliver messages, controlling the mobility of autonomous agents, using Message Ferries (single or multiple) to provide communication services for nodes in the network, using snake and runners protocols and using Data Mules.

E. *Coding based approach:* Erasure coding and network coding techniques are used in this approach. In erasure coding technique an original message is encoded into a large number of coding blocks but can be decoded if smaller number of blocks is received. With this technique worst case delay can be significantly improved. In network coding, intermediate nodes, instead of simply forwarding the packets they receive, can combine some received packets and send them out as a new packet. By using this technique, packet delivery ratio could be much higher.

V. DTN COMMUNICATION IN VANET [3]

There are several works that apply DTN routing techniques in VANETs. Yang and Chuah presented Ferry Based Inter domain Multicast Routing Scheme (FBIMR) in DTNs where ferries are used to deliver multicast messages across groups that are partitioned. They are investigating how different buffer sizes, numbers of ferries and ferry speeds impact on the delivery performance in VANETs. They concluded that by increasing the buffer size (from 1000 to 2500 packets) the delivery ratio is improved but the average delay is increased and data efficiency is decreased. Furthermore, when the packet rate is higher than 1 packets/s delivery ratio is significantly increased and delay is decreased. With increasing the ferry speed from 15 m/s to 30 m/s delivery ratio is much higher and delay is lower.

Zhao et al. propose an infrastructure-to-vehicles data dissemination system with a buffering mechanism to increase the data dissemination coverage. In their system, there are several data centres installed along a road. These data centres periodically broadcast data to the vehicles along the road. This procedure is called Data Pouring (DP). The vehicles that receive a broadcast buffer the data and re-broadcast it in the intersections. Therefore, the system covers not only the road covered with data centres, but also the intersecting roads. The authors call this mechanism as DP with Intersection Buffering (DPIB).

VI. CONCLUSIONS

I can conclude that there are lots of scope still present in VANET based traffic information sharing among all vehicles.

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