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WIRELESS VEHICULAR NETWORK BASED COMMERCIAL ADVERTISMENT DISSEMINATION (VCAD)

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ABSTRACT

The VANET will facilitate new applications for e-business that will revolutionize the driving experience, providing everything from instant, localized traffic updates to warning signals when the vehicle ahead abruptly brakes. In the emerging global economy, e-business has increasingly become a necessary component of business strategy and a strong catalyst for economic development. In near future, vehicles may be equipped with short-range radios capable of communicating with other vehicles and highway infrastructure using a VANET. Mobile Advertisement is a location-aware dissemination solution built on top of a vehicular ad-hoc network. We envision a network of 802.11p that dynamically disseminate data to clients running on the car's smart device. The approach can be considered an alternative to the static advertisement billboards and can be useful to business companies wanting to dynamically advertise their products and offers to people driving their car. The clients can subscribe to information based on specific topics. We present design solutions that use RSU in 802.11p network for transmitting messages to wireless-enabled devices equipped on vehicles. We also present implementation details for the evaluation of the proposed solution using a simulator designed for VANET application.

Keywords: VANET, VCAD, advertisements dissemination, CCH utilization.

INTRODUCTION

Since the existence of Internet, the quantity, quality and diversity of available content shows positive impact which has attracted advertiser as one of immense opportunities to attract more new customers for business purposes. Nowadays the on line advertising is more flexible where it offering contextual and targeted advertising compared to the traditional method using out-of-home billboards or radio and TV advertising. Changing advertiser's investments from traditional to internet advertising is such a dynamic nature. The first advertising banners [1] were sold around 90's which has become a turning point of the transition on online advertising. Result to that, the number of Internet advertising market steadily increased over the years. This is based on the [4] where internet advertising in US during 2001 which only $7 billion drastically increase to almost $32 billion in 2011. This is because the worldwide famous social media space and search engines become one of the best medium for internet advertising. Google, Yahoo, Microsoft and recently Facebook are among the popular social media sites with higher rating users. Yet Google gain almost 97 % of its revenue from internet advertising during 2011[2]. There are three types of revenue model commonly used by the advertising companies such cost-per-mile, cost-per-click and cost-per-view. For cost-per-mile model, every single advertisement displayed will be paid by the advertiser. While the charge for cost-per-click is only be charged if advertisement been click or open by the user and this type is more specific to certain website. Where the selection of a specific advertisement content of a website could be displayed is based on the content of a search performed in a search engine, the history of a specific user or its localization. Where, cookie will be used by advertiser in tracking users' history such as which websites the user visited or advertisement the user clicked. Recently, the evolution of smart phone and its applications has impacted a lot to the existing advertising model. Mobile advertising has become more popular as an advertising platform rather than the Internet advertising. With the increasing of smart phones in market, it improves rich data for the advertisers where they could see the highest websites that user visited. However, there is a limited size available for the advertising using the smart phone and result to this, the advertisement will lack attractive and this can be consider the main concern for time being. The higher costs associated with the Internet traffic inside the cellular network is one of the concern issue which implicated high costs to the user. In terms of units sold, the smart phones have already beaten the traditional computers. Pertaining to this, it is expected that the increase trend of internet mobile advertising will soon become just like the traditional way of advertising which its main target for the audience is the driver group as they

are the one in highest rank of a radio user. But still, it is an inefficient in term of localization on the Internet. This could change in the near future with VANETs application.

VEHICULAR AD HOC NETWORK

Vehicular Ad hoc Networks (VANETs) is communication between vehicles and vehicles which known as V2V and communication between vehicles and infrastructure such as RSU called V2I. Vehicles in VANET have embedded smart technology of OBU (on board unit) which allow wireless communication along the road [5]. Yet, in future driverless cars will be possible with the help of VANET applications and technology. As the vehicle on the road is keep increasing, the need of vehicular communication applications such as safety and traffic alert highly on demand with some Internet access for general used. The ad hoc network which can connect the vehicles moving on the roadway is known as a VANET. In addition, VANETs are characterized by high mobility, rapidly changing topology, ephemeral, and one-time interactions. In coming years, vehicles will be equipped with an increasing number of vehicles equipped with on-board wireless devices with and sensors for improve the efficiency and safety of transportation and management applications. It includes reducing the travel time ad avoiding any traffic congestions flows of vehicles. For an immediate response, traffic congestions can be sense through radar and automatically will slow the vehicle. In other accident warning systems, a sensor can be link with the vehicle air bag system and it will transmit the pulse if one of the air bag deployed and then, this information will be relayed via V2V or V2I within the vehicular network. Smart vehicles in the future will have advanced functionalities which allow communication, data sharing and smart road assistant.

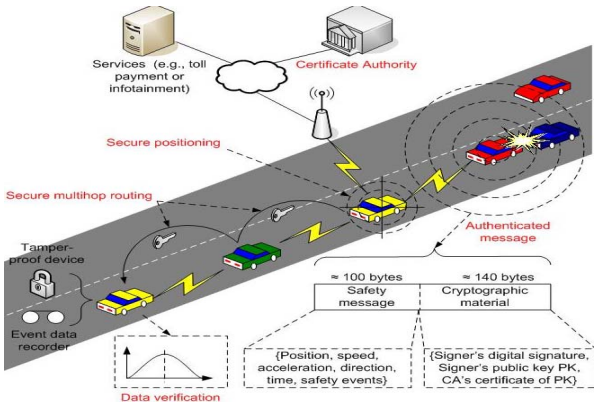

Figure-1. VANET architecture with infortainment service (e.g: Advertisement) [1].

Figure-1 shows the brief architecture of Vehicular ad hoc networks (VANETs) on the road. The application of VANET consists of one on-board units (OBUs) built into vehicles and two roadside units (RSUs) deployed along highways or sidewalks, which facilitates both vehicle-to-vehicle (V2V) communications between vehicles and vehicle-to-infrastructure (V2I) communications between vehicles and RSUs. Each of vehicles communicates in a highly dynamic ad hoc networking environment via wireless communication link. All the information regarding the traffic can be exchanged via V2V communications (e.g., through periodic beaconing) and this will give awareness to the drivers of traffic conditions and for drivers to do a quick decision. In case of danger, emergency messages can be generated and disseminated to the vehicles.V2V communication also support entertainment application such peer to peer file sharing and gaming.

BACKGROUND

The data dissemination that allows all users on board of vehicles to receive information relevant to services available in the considered area (we name it service area) is the main component of the infotainment services. In the VANET context, data dissemination starts from a Road Side Unit (RSU) and propagates to a multiplicity of On Board Units (OBU). A RSU typically can reach with a single hop only a fraction of the interested vehicles, related to its radio transmission range. Multi-hop, inter-vehicle communications is necessary to reach vehicles in the whole area that could be interested in the service. The aim is to cover an extended area around the RSU that has originated the contents. Vehicular Ad-Hoc Networks (VANET) is attracting the interest of network operators and service providers for the provision of infotainment services [5]. The communication standard that will be used for inter-vehicular communications is the IEEE 802.11p [6] also known as Wireless Access in Vehicular Environments (WAVE). The WAVE protocol standards (802.11p /1609) aim at providing a set of specifications to allow interoperability between wireless devices on board of vehicles (On-Board Unit, OBU) and devices located near the roads (Road Side Unit, RSU). We can make a decision between safety related messages, which need to be transferred in real time (fractions of seconds), but affecting an area of the order of the coverage area of a RSU/OBU, and messages related to traffic information, road conditions, local utility information and so forth, which should be disseminated in an area of several kilometres, but having less stringent delay requirements (seconds or tens of seconds). In these kinds of services, also called Non-Public Safety services, we can list traffic information, electronic toll collection, advertisement, parking lot payment, video streaming services and many others.

RESEARCH PROBLEM

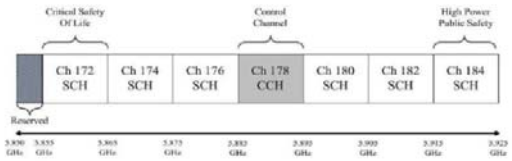

Figure-2. DSRC channel.

All seven channels are divided on a priority basis. Since accident is not always happen even it is top priority, thus it caused inefficient CCH dissemination. This will cause the wastage of channel due to low CCH utilization in the fix duration intervals between CCH and SCHs IEEE 1609.4 standard. Besides, safety and non-safety data like commercial advertisements will be inefficient too, the duration of CCH should be reduced in the absence of safety messages and be used for the purpose of broadcasting the non-safety real-time and non-real-time data which is our commercial advertisements to keep balance and run at high efficiency in data transmission protocol. Thus, the durations of CCH and SCHs can be adjusted dynamically to improve the channel utilization. Channel utilization, defined as the ratio of the number of retransmitting nodes to the number of nodes that successfully receive the broadcast message.

EXISTING SOLUTIONS

Vehicular ad hoc networks applications divided into three main categories. First, infotainment dissemination category which provide entertainment to driver and passenger. Second, road safety category which provides safety messages communication between vehicles and road site unit in case of emergency. While third is traffic monitoring and management [4] [5] which more to manage traffic flows and traffic information. Yet this research falls into the infotainment dissemination category. Convenience and comfort to drivers are the main purpose of infotainment application. For example, the author [6] provide peer to peer file transfer and gaming on the road. A real time parking navigation system is proposed in [7] to inform drivers of any available parking space. Digital billboards for vehicular networks are proposed in [8] for advertisement. Internet access can be provided through V2I communications; therefore, business activities can be performed as usual in a vehicular environment, realizing the notion of mobile office [9]. On-the-road media streaming between vehicles also can be available [10] [11], making long travel more pleasant. Unlike previous solution, we propose an approach that takes advantage of short-range wireless network communication. As far as we know it is an idea different from previous solutions by at least: the ability to transfer data without establishing a connection beforehand and the fact that the information is confined to the geographical area in which it could be useful.

BUSINESS MANAGEMENT PERSPECTIVE

Potential

This application has the potential to replace the static and more expensive advertisement traditional billboard panels. There are advantages for both the driver, as well as the business provider. The driver is presented with less information, which is more relevant to its specific needs. The business provider advertises its products in a more efficient way. Typical scenarios include a restaurant dynamically advertising its menu or a store advertising its discounts. Or the administrator of a road decides to do some maintenance work on a specific portion. In this case he/she could place APs at locations leading up to the affected area, informing drivers of the hardened driving conditions and possibly offering advice about alternative routes. Besides, it offers convenience and comfort to drivers and/or passengers by inform drivers of any information type. Therefore business activities can be performed as usual in a vehicular environment, realizing the notion of mobile office

Target user

There are advantages for both the driver, as well as the business provider. The driver is presented with less information, which is more relevant to its specific needs. The business provider advertises its products in a more efficient way. Typical scenarios include a restaurant dynamically advertising its menu or a store advertising its discounts. Or the administrator of a road decides to do some maintenance work on a specific portion. In this case he/she could place APs at locations leading up to the affected area, informing drivers of the hardened driving conditions and possibly offering advice about alternative routes.

Innovation

One of the most important sources of revenue for big Internet-based companies is advertisements. With vehicular networks poised to become part of the Internet, this new “edge” of the Internet represents the next frontier that advertising companies will be striving to reach. As advertisers struggle to reach increasingly distracted and jaded American consumers, they have sought non-traditional media for their advertisements (Ads), from elevators to cell phone screens. Content-targeted advertising paradigm has proved to be a resounding success in advertising on the conventional Internet. As the Internet expands to mobile devices, even vehicular nodes are becoming a part of the “edge” of the Internet. Several interesting challenges in application design arise, while designing a targeted ad delivery mechanism for cars.

His mobile business advertisement is a location-aware dissemination solution built on top of a vehicular ad-hoc network. We envision a network of 802.11p that dynamically disseminate data to clients running on the car's smart device. The approach can be considered an alternative to the static advertisement billboards and can be useful to business companies wanting to dynamically advertise their products and offers to people driving their car. The clients can subscribe to information based on specific topics. We present design solutions that use access points as emitters for transmitting messages to wireless-enabled devices equipped on vehicles. We also present implementation details for the evaluation of the proposed solution using a simulator designed for VANET application.

THE PROPOSED VCAD

Overview

People will take several hours to reach final destination either by using highways or not. Audio, videos, games and various offers from nearby interchange R&R especially commercial advertisement are some applications that help people to overcome tiredness and boredom. User can share all the informative data including the advertisement via VANET by disseminating between vehicles and infrastructure along the road. In CCH system, exchanging safety message during danger or while approaching danger zone is such a top priority. Commercial ads are categorized as non safety data which have low priority. All seven channels are divided on a priority basis. For commercial advertisements (including audio and games) and non-real-time data are considered to be Category II with label as Priority 3. CCH is totally meant for exchanging the safety messages as emergency data and is therefore dedicated for the data with the highest priority label as Category 1 and Priority 1 while Videos and graphics are considered to be Category I with Priority 2. Text messages and emails which fall under non-real time data are considered to be under Category III with the lowest Priority 4. All the data fall under Category 1 Priority 1 will be transmit only via whereas the rest of the six SCHs are used to transmit the data for other categories. Since accident is not always happen even it is top priority, thus it caused inefficient CCH dissemination. This will cause the wastage of channel due to low CCH utilization in the fix duration intervals between CCH and SCHs IEEE 1609.4 standard. Besides, safety and non-safety data like commercial advertisements will be inefficient too, the duration of CCH should be reduced in the absence of safety messages and be used for the purpose of broadcasting the non-safety real-time and non-real-time data which is our commercial advertisements to keep balance and run at high efficiency in data transmission protocol. Thus, the durations of CCH and SCHs can be adjusted dynamically to improve the channel utilization.

Figure-3. Smart vehicle with driver assistant screen for safety message and infotainment message such as advertisement.

A. Advertisement Transmission

Today, GPS is installed in most of vehicles. The vehicle which has send the data for transmit known as provider while the vehicle that receive the data known as receiver. The transmission protocol is designed for the VANET system and best used for highway scenario with m lanes along each side. The location to place the RSUs are before interchanges, and the distance between RSU units is k km (the k value can be vary depending on the distance between interchanges). Any sensor node in a vehicle senses events, aggregates the measured values and transmits to the OBU of the vehicle. At the same time, the OBU broadcasts the same information to nearby vehicles and APs within its communication range. Various physical quantities, such as temperature, humidity, surface conditions on the roads and also detected moving obstacles will be transmit by the sensor to the OBU. The OBU will process the information received and potentially displayed to the driver in the vehicle. The OBU will alert a safety warning message immediately once received the dangerous situation which processed by the sensor. The OBU system will trigger to all vehicles in a certain geographical region, potentially using wireless multi-hop communications. The duration of the safety warning message is considered to be 100 units, which is partly used for CCH and is partly used for SCH. The back off time is set in such a way that a vehicle which is far away from the location of the accident location can broadcast first for the acceleration of the message propagation. As a result, vehicles which received an alert can make an immediate decision to channel its route with other road or continue with some information on the incident. It is to be noted that in our protocol, the propagation of an identical message is limited within two consecutive RSUs. As soon as any vehicle carrying the message comes within

communication range of an RSU, it has to upload the message to the RSU. Additionally, it also needs to download any new messages cached in the RSU, which it carries until reaching another RSU.

SIMULATION

A. Scenario

We proposed VCAD in a hybrid vehicular ad hoc network taking wireless sensors and vehicles into consideration. The different between other hybrid VANETs with ours is the sensors where it is mobile, as they are fitted inside vehicles. We use several road access point (APs) and a few smart road side units (RSUs) in order to improve the speed and reliability of safety message during the transmissions. For our protocol, RSUs are located only near to the interchanges of roads. The used of RSU for implementing mobile advertisement is more attractive. In our proposed architecture, there are RSU, which can communicate with the vehicles using the IEEE 802.11p channel access protocol and as well with wireless sensors using the IEEE 802.15.4 MAC protocol. Since our research specifically for highway scenario, therefore it can be assumed that there are several interchanges of exit from the highway in case any event is reported. The function of RSU is to upload and download wirelessly the data from and to vehicles using either IEEE 802.11p or the IEEE 802.15.4 MAC protocol whenever any vehicle is passing by within its communication range. The best location to place the RSU unit is at least 2 km before each interchange, so that the RSU can transmit the data to the vehicles about any event upcoming. In our proposed architecture, one ZigBee-enabled wireless sensor is fitted at the front end of each vehicle to detect events, which is very common nowadays in most modern vehicles. These wireless sensors operate in the unlicensed ISM 2.4 GHz band and use the IEEE 802.15.4 protocol for communicating with each other. There are several APs in between RSU which has similar function to RSU which can transmit and receive data from wireless sensors using the IEEE 802.5.4 communication protocol. The s acts as a bank to collect data from sensors and can act as intermediate nodes to transmit the event information to the next hop, which can ultimately be transmitted to RSUs.

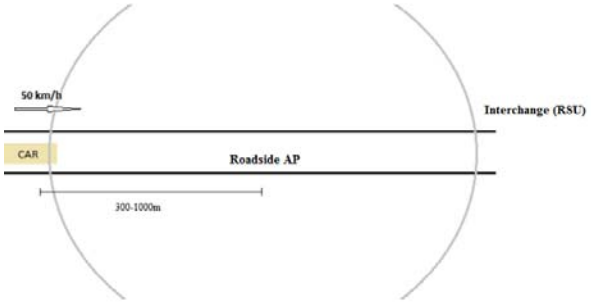

Figure-4. VCAD scenario on highway with the RSU in interchange and AP along the highway.

A. Assumption

An on-board unit (OBU) is attached to the vehicle, which can act like a smart gateway to receive data from sensors for further processing. The function of OBU is to analyze all the data received and then transmit to the other vehicle's OBU within its communication range. Sensors fitted in each vehicle can transmit data to the OBU of the same vehicle by using wired cables in order to avoid collisions or interference by using the wireless medium. Each OBU communicates with other OBUs wirelessly using the IEEE 802.11p protocol. In between two RSUs, the data are broadcast from one OBU to another in a multi-hop system. As soon as a vehicle arrives within the communication range of any RSU, the information of events from the vehicle's OBU is automatic uploaded to the RSU using the IEEE 802.11p communication protocol, and the information of events received either from other vehicles or from the intermediate is downloaded to the vehicle's OBU using the IEEE 802.11p communication protocol. In the proposed VCAD, other sensors will communicate by using the IEEE 802.15.4 protocol. Each vehicle can transmit data to the RSU using the IEEE 802.15.4 communication protocol since each RSU supported both IEEE 802.11p and IEEE 802.15.4. In order to improve data reliability, The RSUs will receive the data and event information from the vehicles passing from time to time. While the IEEE 802.11p protocol will allow any OBU communicate with other OBUs in ease commercial ads message exchange.

RESULT AND ANALYSIS

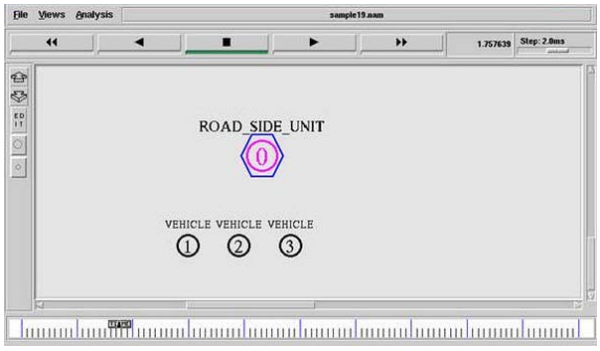

Figure-5. Simulation environment in NS2.

To evaluate, we enhanced the ns-2.35 simulator to support the novel IEEE 802.11p technology. We selected the most representative parameters for VANETs, and then we defined and simulated a basic scenario.

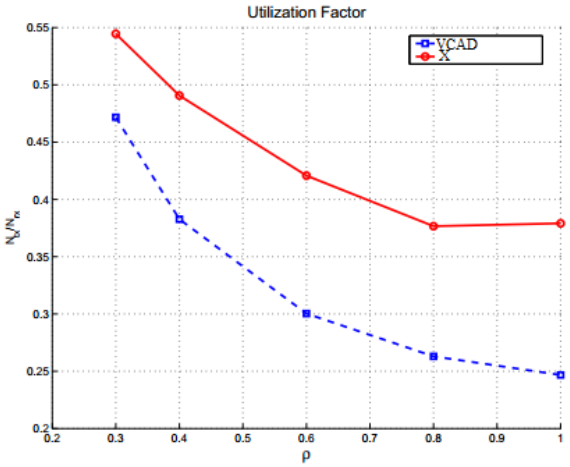

Figure-6. Channel utilization.

Results are presented as functions of the vehicle density and give an insight on the efficiency of the proposed schemes with respect to flooding, where the number of retransmitting nodes is equal to the number of receiving nodes (i.e., the flooding utilization factor is always equal to1). The plot shows that the VCAD outperforms the X[16]. Since we used the empty esafety message channel to disseminate our business advertisement data. This will improve the wastage of channel due to low CCH utilization in the fix duration intervals between CCH and SCHs IEEE 1609.4 standard. Thus our commercial advertisements will be efficient because it will reduce the duration of CCH in the absence of safety messages and be used to disseminate our commercial advertisements in order to keep balance and run at high efficiency in data transmission protocol. Thus, the durations of CCH and SCHs successfully are adjusted dynamically to improve the channel utilization.

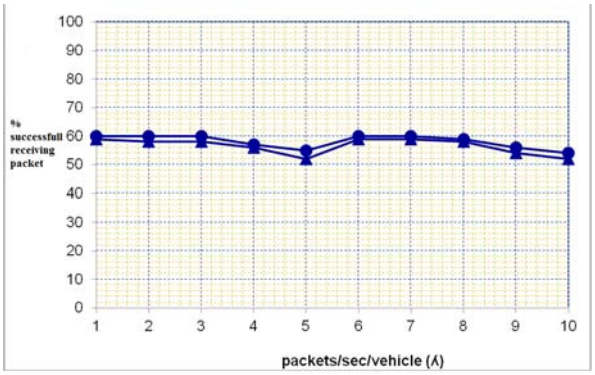

Figure-7. Packet size.

The simulation results when varying the number of nodes and maintaining the rest of parameters unaltered. The basic scenario of 25, 50, 100, 150 and 200 nodes were selected. As what we expect, when the node density increases the propagation delay is lower. About 60% of the vehicles will reach the information in less than 0.2 seconds, and propagation is completed in less than 0.9 seconds. With 200 nodes in simulating, propagation was completed in only 0.5 seconds. This characteristic explained the flooding propagation of the messages works better with higher node densities. When the number of nodes increases the number of packets received per node slightly decreases due to the collision occurred. The size of the packets sent does not affect the warning advertisement system's behaviour.

CONCLUSIONS

Mobile advertisement VCAD is developed on top of a wireless communication infrastructure that provides vehicles on the road with advertisement information related to their current location. It can be useful to business companies because they can dynamically advertise their products and offers to more people driving their car. We presented a solution for implementing such a system, based on the idea of using APs and RSU as emitters for transmitting messages to wireless-enabled devices equipped on vehicles. Such a solution provides a practical and inexpensive approach for delivering information to vehicles with wireless devices. We presented the approach taken for disseminating business advertisement message by using the unused safety message channel available in the 802.11p protocol suite. Thus, it improves the wastage of channel due to low CCH utilization in the fix duration intervals between CCH and SCHs IEEE 1609.4 standard.

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