A Survey on Roadside Units Using Vehicular Adhoc Networks

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Abstract

The future application of vehicular ad hoc network (VANET) will be event driven and it will delivered different types of events to moving vehicles within a specified time. In this paper we propose publish-subscribe based communication framework for such environments in which vehicles subscribes to the service provider (SP) through Roadside units. Only a finite number of events can disseminate at a time, it has a cost associated with it. The formulations of RSUs are done to schedule the disseminations of events using two scheduling problems. The first problem aims to maximizing the number of subscriptions. The problem is to maximizing and matches the number of subscriptions, also aims to minimize the total cost of disseminating the events. The offline and online algorithms are designed for the problems that a service provider can execute to schedule event dissemination from the RSUs. Detailed simulations results are presented to show that the algorithms are able to match a high percentage of subscription with low average event dissemination cost for some realistic city traffic scenarios.

Keywords- Event Dissemination, Scheduling, Publish-Subscribe, RSUs, VANET

I. INTRODUCTION

A vehicular ad-hoc network (VANET) is a kind of mobile ad-hoc network where nodes are moving vehicles and communication can be vehicle-to-vehicle (V2V), or vehicle-to-infrastructure (V2I). The infrastructure is usually deployed on the roadside, also referred to as road-side units (RSUs). The RSUs can be used as broadcasting nodes and are usually connected to the internet through some backbone network. Typically, such VANETs have become an important area of research with potential applications in various domains such as safety, navigational applications, in vehicle infotainment etc. Many future applications will be event-driven and will require events of different types to be delivered to vehicles. Events can be delivered to vehicles by using V2V or V2I communication, or by a combination of both. Using V2V communication for event dissemination causes redundant message delivery, and usually cannot tolerate network portioning. Several works have explored the problem of delivering the events through RSUs. RSU proposes publish-subscribe framework based scheme for low cost dissemination of events.

RSU can broadcast an infinite number of events at one time, which is not practical due to limited bandwidth of the RSUs. In this paper, we consider a more realistic model where each RSU has finite capacity, i.e., only a finite number of events can be broadcast from a RSU at the same time. Under this model, we propose a Publish-subscribe based framework for event dissemination in which vehicles subscribe to a single Service provider (SP) for specific type of events through RSU. The SP schedules events at RSUs for appropriate time intervals such that the vehicles can receive the events within the validity periods of both the subscriptions and the events. The SP should also aim to minimize the total cost of disseminating the events. We formulate two scheduling problems: the Bounded Maximum Subscription Matching (B-MaxSubMatch) problem aims to maximize only the number of subscription matched, while the Bounded Minimum Cost Maximum Subscription Matching (B-MinCostMaxSubMatch) problem also aims to minimize the total cost of event dissemination while maximizing the number of subscription matched.

The main contributions are as follows:

- The formulation of B-MaxSubMatch and the B-MinCostMaxsubMatch problems for event dissemination through RSUs with finite capacity is defined.
- The B-MinCostMaxSubMatch problem is proved as the NP-complete problem.
- The B-MaxSubMatch problem is proposed by an offline algorithm. The result of simulation in different city traffic scenarios shows that the algorithm matches the subscriptions in most scenarios.
- The B-MinCostSubMatch problem is proposed by an offline algorithm. The result of simulation shows that the offline algorithm for B-MaxSubMatch in terms of cost for event dissemination has too much on the subscriptions matched percentage.

– The B-MinCostMaxSubMatch problem is proposed by an online algorithm that considers the subscriptions in real-time environment. The result of simulation shows that this delaying helps in reducing event dissemination cost for most scenarios.
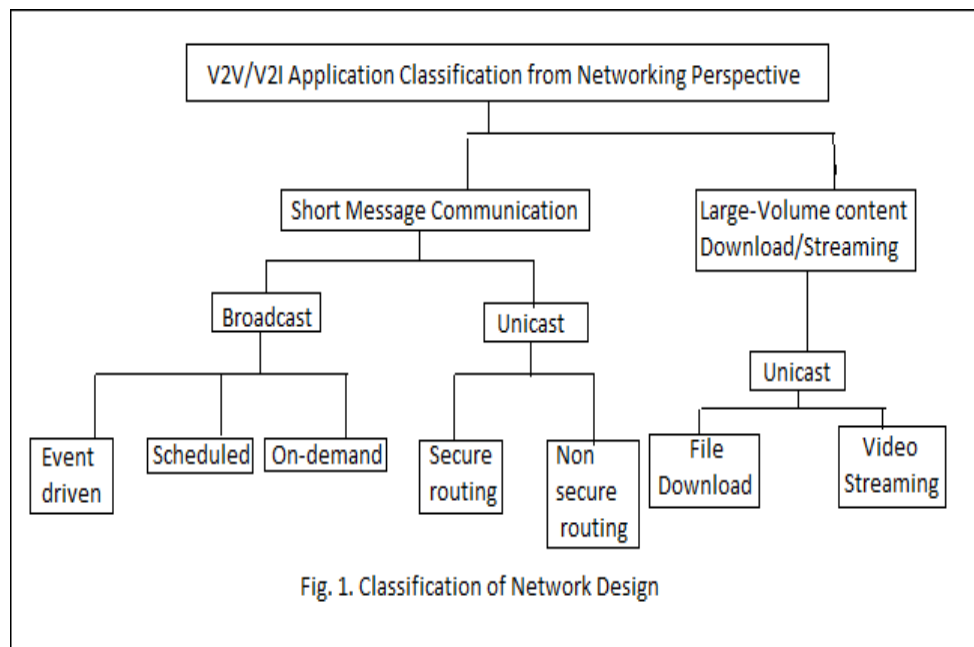
II. V2V COMMUNICATION

Information dissemination in vehicular environments has been traditionally done with some variation of flooding. This work is done using V2V and V2I communication. For large number of vehicles, only V2V communication is not enough since it causes redundant message delivery. To reduce the redundant broadcast a contention mechanism is used to select intermediate vehicles (publishers) which will re-broadcast the message so as to carry forward the propagation. This approach cannot handle network partitioning. The connected component of VANET containing the publisher stops the propagation at the boundary. The congestion based information dissemination method is proposed to estimate the vehicle to decide whether the re-broadcast the information or not. The approaches used in the system are message –centric in nature. The aim is to attain maximum coverage in terms of vehicles. Works on event notification for vehicular networks addresses the issues of delivering the information for event from a moving vehicle to a fixed destination. The performance of geo-casting events increases the overhead, and for highly congested areas this approach is infeasible. A recent works propose a navigation system that is used to route the request to the RSU closest to a moving vehicle. The cost usage of RSUs will not reduce by this approach. The subscriptions and event has validity period associated with them and cost usage of RSUs will not consider by this approach.

III. THE PROBLEM OF MINIMUM COST PLACEMENT ALGORITHM

In this scenario the vehicles are subscribe to different types of events of interest at different locations on their way to the destination. The validity period associated with each of these subscriptions has to be satisfied. Through RSUs closest the subscriptions are reported to the service provider on its route after the subscription is raised. In different parts of city at different times the different event will occur. Event has validity period beyond which the event information may not be any use. Through RSUs the events will be reported to the service provider or directly through the backbone network depending on where the event is raised. The set of events and set of subscriptions while receiving by service provider decides which event should be placed in which RSU and in what duration. By the service provider RSU will broadcast information about the events. The event information will be received to vehicle when it is within the range of an RSU. There are some conditions satisfied by an event broadcast raised by subscriptions:
1) The event type is equal to the subscriptions type.
2) The RSU is in the route of the vehicle.
3) In the valid period of both subscription and the event, the vehicle passes the RSU at a time.

The capacity of RSU is finite, the number of events that can be placed in a single RSU. Each RSU has a cost of usage per unit time. The placement of the events to the RSU satisfies the subscriptions of all the vehicles are optimize by the service provider. This problem is Minimum Cost Event Placement Problem.
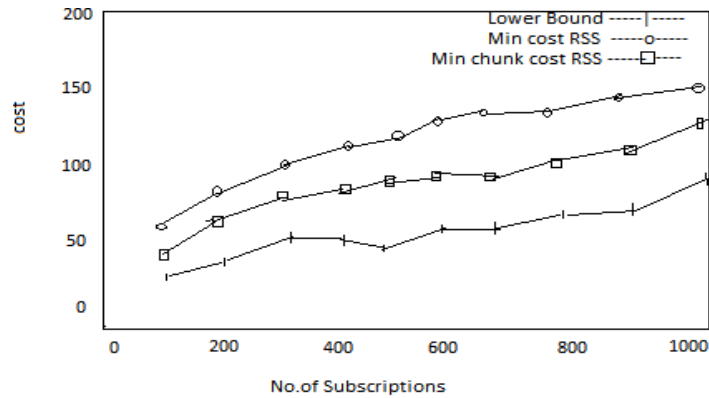

Fig. 1. Classification of Network Design

Fig. 2. Traffic converging to one central location

There are four typical modes for V2V communication.
− Silent mode (no V2V): There is no possible for spectrum reuse and cellular links in all available resources. There is no transmission of data and to be silent.
− Reuse mode (V2V underlay): There is a direct transmission of data in V2V devices by reusing resources of cellular network. The reuse of spectrum can be either uplink or downlink communication.
− Dedicated mode (V2V overlay): The dedication of cellular network can be a portion of resources for the direct communication for V2V devices.
− Unique mode (V2V only): This mode is totally varied from silent mode. The available resources use V2V devices, the communication of cellular networks stay silent.

Here underlay reuse mode of V2V devices is focus to overcome the issues therein include design of transportation protocol, power control, allocation resources.

A. Impact of Renewable Energy and Electrification Transportation
In all major transportation markets the context of intelligent transportation system will be developed. This is done to establish an intelligent SG infrastructure due to transportation electrification and renewable energy. The electrification of the power train of vehicles is connected to the transportation electrification; the aim is to require new forms of energy transfer and energy storage. To reduce the current dominant role of internal combustion engine (ICE) vehicles the battery system with high power density is used. To transfer energy at comparable speeds to gasoline fuel pumps using charging system in the future.

B. Impact of Transportation Infrastructure for Information on Communication System
The interaction between data centers, mobile device, transportation vehicle and transportation energy distribution infrastructure is establish by broadcast wireless network infrastructure. The growth of hyper dynamic over the smart phones and tablets in the last few years of mobile connecting devices in a longer transaction period has a stationary processor and data storage item in communication network. And excellent opportunity of this development is to implement the physical network in which people can be able to use the standardized technology and interfaces in an efficient manner. The active control mechanism (e.g., speed control) replaces the traditional passive information sources to impact traffic (e.g., FM radio). The vehicles are being monitored and controlled by the data centers to require bidirectional communication between vehicles.

C. Financing the Infrastructure Transportation for the Future
To generate revenue in the private—public partnership, the cost of finance transportation infra-structure and the development of new infra-structure is required. The challenges of transportation infra-structure are as follows.
1) The maturity level of overall growth of transportation is high as vehicle becomes the general efficient of more fuel.
2) The essential transportation of future needs to be considering the cost calculation of transportation infra-structure.
3) The requirement of ICT (information and communication technologies) has includes the active control technologies of V2I that include the cost calculation of the transportation infrastructure.
4) Vehicle components are to be invested to interact with the intelligent transportation infrastructure via interfaces.

A promising concept is instead of collecting gas tax, to collect road usage based on vehicles miles travelled (VMT). Once the VMT is installed, it is used to collection of fees for energy related services and the additional information. It can operate both in public or public agent or public/private partnership.

D. *Role of Smart Charger*

The development of smart charging infrastructure supports the expansion of vehicle electrification. Dynamic wireless charging (Charging of vehicles electrically in motion), Quasi-dynamic charging (charging of vehicles electrically that are stop during enroute are been introduced. With the introduction of mobile charging cites, an area of future research might changes the patterns of research. In particular, smart parking system urban areas the implementation of SG components is required a renewable energy source into the zero emission transportation energy.

IV. SYSTEMS AND SERVICES

A. *Physical Constituent of Cyberspace Counterparts*

The inevitable occurrences of cyberspace are integration and interaction of the vehicle, the infrastructure, the traveler has the features of cyberspace counterparts. It has physical components as follows.

1) *Integrated EV Energy Management System*

The impact on future building energy management and the development of the (NEZB) net-zero energy buildings uses the penetration of EV. The nighttime residential charging and the power demand of valley filling problems are focused by strategies of EV charging mechanism. The charge of parking-lot at commercial buildings will be an attractive solution for the people who used to park their EVs at the attachment of parking lots. It can reduce the capacity of onboard battery from round trip to one way. It will bring obsolete challenges at the level of distribution. The SG and building control system, the communication system, the vehicle-borne ITS, building information management and even the enterprise resource planning (ERP) of cooperation would be correctly merged for a win–win situation for better building operation, better vehicle charging and better enterprise in future.

2) *Simple Operation and Simple Visualization*

Visualized system gives much information and offers little utility value. A system should show required information but not the complicated one, it is highly sophisticated and processed. It is called case in an operation. Simple operation will not operate all house hold appliances from terminals, like personal digital assistance (PDA) because it is not essence of home energy management system. E.g. Air conditioning machine since it is intelligible and instinctive and can be used by old person and even child.

3) *Smart Grid Data Center and Integrated ITS*

To navigate EV to the optimal battery charger, a local balance of electric power should give a command when the SG observes. Hence SG and ITS information together managed. An ITS center for navigation and an SG center for reserving the electricity is required for EV quick charger. The charging state of information of this battery is useful in getting the information for electric power system stabilization. The local electricity balance and interaction with SG system will help to control these batteries.

4) *Distributed Hierarchy of Cloud Service*

The data size may increase due to unifying the information on both SG and ITS infrastructure. It also increase management and calculation cost when all the information is centralized into cloud and return to the local. Finally, to facilitate real-time or time-critical service become difficult because due to increase in calculation and communication delay. The delay of 10 ms or less is required by stabilization of electric power grid.

V. SIMULATION

The simulation results in obtaining the protocol and to evaluate its performance. The simulation here implemented is NS2 (version 2.30). This scenario models a straight 5 km long highway with 2 lanes. The vehicle distribution and their velocity from freeway traffic model is to be determined. This protocol varies percentage of equipped vehicle from 10% up to 100% to cover extreme values.
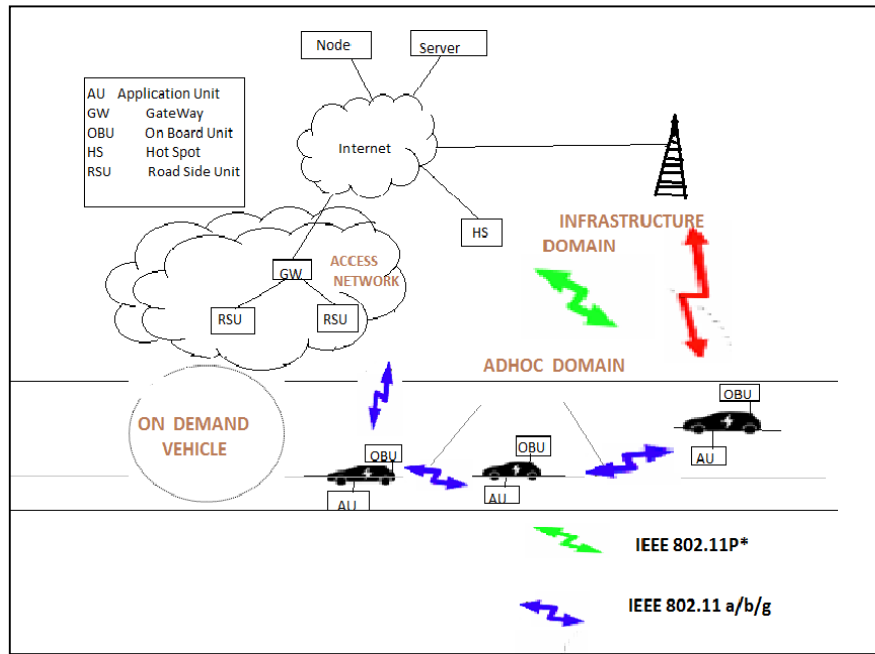
Fig. 3: Block diagram of VANET using RSU

Table 1: Simulation Parameter

1	*Parameter used*	*Value*
2	*Percentage of equipped vehicles*	*10%-100%(25-250 nodes)*
3	*Speed of Vehicles*	*80~120km*
4	*Number of Lanes*	*2 Lanes*
5	*Radio Ranges*	*IEEE 802.11*

VI. CONCLUSION

In this study, the characteristics of various communication based automotive applications in systematic manner is analyzed and classified into several abstract and generic categories. For this application the design and network protocol implementation stack is done using the effort facilities of application characterization and classification. Both application characteristics and networking attributes with rich set of attributes of the application is proposed first. This is done to better capture of properties of various applications. We analyzed the attributes of Vehicle-to-Vehicle and Vehicle-to-Infrastructure applications. The future work considers the characteristics for improving delivery ratio of dissemination process.

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