A REVIEW ON OPTIMISTIC TOWER DEPLOYMENT TECHNIQUES IN VANETs

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Abstract-**This paper presents a survey on optimistic tower deployment techniques or Roadside Units (RSUs) in VANETs and what are their limitations. Vehicular ad hoc networks (VANETs) are becoming the hot issue in today's intelligent vehicular systems. VANETs consist of some vital components: RSU, OBU and Trusted Authority. Among them RSUs is one of the fundamental components of Vehicular ad hoc network (VANET). Roadside Units (RSUs) are placed across the road for infrastructure communication. But the deployment cost of RSUs is very high, so to deploy more and more number of RSUs across roads is quite expensive. Thus, there is a need to optimally place a limited number of RSUs in a given region or road in order to achieve maximum performance. This paper has presented various techniques proposed so far by different researchers to optimally place the RSUs.**

Keywords **: VANETs, RSUs, Parallel algorithms, Intelligent Transposition Systems.**

I. INTRODUCTION

The main motive of this research work is to take advantage of the benefits of parallel processing for optimally deploying roadside units across the roads. Research in Vehicular Ad Hoc Networks (VANETs) has attracted the attention of both the industry and academia. But it has been found during the literature survey that the parallel algorithms have been neglected by most of the researchers in the field of VANETs. So, in this study an effort has been made to use parallel processing for efficiently deploying RSUs in VANETs.

The cost of the RSUs are too high so it is not possible to deploy more and more RSUs to cover the given road, so need of the hour is to deploy them optimistically, such that the minimum number of RSUs can cover maximum range. But it is found that optimistic deployment of RSUs takes too much time i.e. serial time. So in order to reduce the amount of time required to do the same, a new algorithm is required.

Intelligent Transportation System (ITS) is the main component of VANETs [3], [9]. In Intelligent Transportation Systems (ITS), each vehicle broadcast the information to the vehicular network or transportation agency, which then uses this information to ensure safe and free-flow of traffic. The possible communication configurations in ITS are inter-vehicle, vehicle to roadside, and routing-based communications [3]. All this configurations requires precise and up-to-date surrounding information.

A. Inter-vehicle Communication

Inter-vehicle communication support multi-hop multicast/broadcast over a multiple hops to a group of receivers. ITS are generally concerned with the activity on the road ahead and not on road behind. Naïve broadcasting and intelligent broadcasting [3] are the two message forwarding methods used in inter-vehicle communications.

Naive broadcasting believes on the periodic broadcasting of message, if the message is from a vehicle behind it then vehicle ignores the message, but if the message comes from a vehicle ahead then the receiving vehicle sends its own broadcast message to vehicle behind it. Due to the large number of messages, probability of message collision increases which lowers the message delivery rate and increases its time of delivery. This problem is overcome using intelligent broadcasting. It uses acknowledgment address limiting the number of messages broadcast for emergency events only.

B. Vehicle-to-roadside communication

In this type of communication, vehicle communication is done using single hop broadcasting method. This type of configuration provides ample amount of bandwidth link between communicating parties. In vehicle to roadside communication the maximum load for proper communication is given to the road side unit, it controls the speed of vehicle when it observes that a vehicle violates the desired speed limit, it delivers a broadcast message in the form of an auditory or visual warning, requesting the driver to reduce speed. Here RSU sends broadcast messages to all the equipped vehicles.

C. Routing-based communication

Multi-hop unicast method is used in routing-based communication configuration. While sending the message, the vehicle sends message using multi-hop fashion until it reaches to the desired vehicle. Receiving vehicle then sends a unicast message to the requested vehicle.

VANETs can be distinguished from other kind of adhoc networks as follows [3]:

Highly dynamic topology: Due to high speed of movement between vehicles, the topology of VANETs is always changing.

Frequently disconnected network: Due to the same reason, the connectivity of the VANETs could also be changed frequently. Especially when the vehicle density is low, it has higher probability that the network is disconnected. However, a possible solution is to pre-deploy several relay nodes or access points along the road to keep the connectivity.

Mobility modelling and predication: Due to highly mobile node movement and dynamic topology, mobility model and predication play an important role in network protocol design for VANETs. Moreover, vehicular nodes are usually constrained by pre-built highways, roads, and streets, so on giving the speed and the street map the future position of the vehicle can be predicted.

Geographical type of communication: The VANETs often have a new type of communication that addresses geographical areas where packet needs to be forwarded (e.g., in safety driving applications).

Various communication environments: VANETs are usually operated in two typical communication environments they are highway traffic scenarios and city traffic scenarios**.** In highway traffic scenarios, the environment is relatively simple and straightforward (e.g., constrained one-dimensional movement), while in city conditions it becomes much more complex. The streets in a city are often separated by buildings, trees, and other unstated obstacles. Therefore, there isn’t always a direct line of communications in the direction of intended data communication.

Sufficient energy and storage: A common characteristic of nodes in VANETs is that nodes have ample energy and computing power (including both storage and processing), here nodes are cars instead of small handheld devices.

Hard delay constraints: In some VANETs applications, the network does not require high data rates but has hard delay constraints. For example, in an automatic highway system, when brake event happens, the message should be transferred and arrived in a certain time to avoid car crash. In this kind of applications, instead of average delay, the maximum delay will be crucial.

Interaction with on-board sensors: It is assumed that the nodes are equipped with on-board sensors to provide information that can be used to form communication links and for routing purposes. For example, GPS receivers are increasingly becoming common in cars, which help to provide location information for routing purposes.

I. Vehicular ad hoc Networks (VANETs)

Wireless communication is ubiquitous because of its flexibility to adapt to different scenarios. Mobile Ad Hoc Networks (MANETS) is a term coined for the continuously varying network topology handheld mobiles devices [1], [2]. VANETs are a special case of the much studied mobile ad hoc networks (MANETs), where the vehicles are the mobile nodes. If and when deployed, VANETs will be the largest MANETs ever implemented. It deploys the concept of continuously varying vehicular motion.

The nodes or vehicles as in VANETS can move around with no boundaries on their direction and speed. Vehicular ad hoc network (VANET) involves vehicle to vehicle (V2V), vehicle to roadside (V2R) or vehicle to infrastructure (V2I) communication [1], [2], [3], [4], [5].

VANET generally consist of On Board Unit (OBU) and Roadside Units (RSUs). OBUs enables short-range wireless ad hoc network to be formed between vehicles. Each vehicle comprises of hardware unit for determining correct location information using GPS. Roadside Units (RSUs) are placed across the road for infrastructure communication.

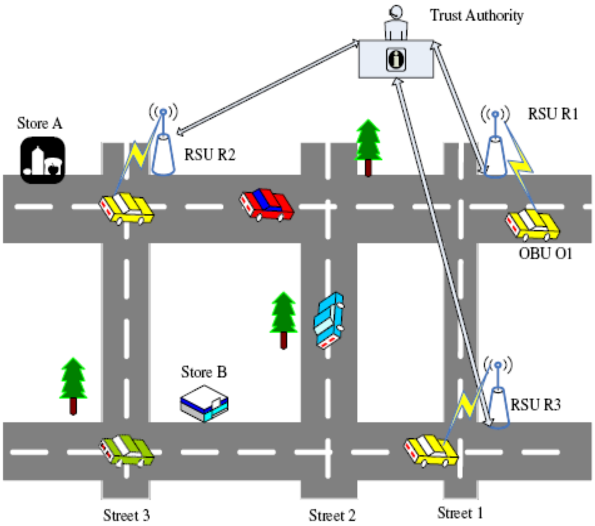

Fig. 1: Network Model

As illustrated in Figure 1, a typical VANET consists of three entities in city scenarios: the top TA, the fixed RSUs along the road side, and the mobile OBUs equipped on the running vehicles [1].

1) TA: TA is in charge of the registration of the RSUs and OBUs. TA can reveal the real OBU identity of a safety message and publishes the CRL periodically to the RSUs. Moreover, TA can be a road authority, such as the government. It has the basic information about streets and traffic statistics, and proposes the RSUs deployment plan according to the tradeoff between the requirements of most OBUs and the investment budget.

2) RSU: RSUs are erected at intersections for the considerations of power and management. RSUs use the same communication technology and the deployment cost is constant at any intersections. RSUs connect with TA by wired links [1], and act as certificate proxies of TA. An RSU can issue short-time certificates for the OBUs with valid membership.

3) OBU: Each OBU has a long-term unique identity. OBUs mainly communicate with each other for sharing local traffic information, and with the RSUs for updating the short time certificates. Digital maps are available for the OBUs. It provides the street-level map, the communication coverage of RSUs and the traffic statistics such as vehicle speed on roads, and traffic signal schedule at intersections.

III. VANETs Applications

1. **Safety related applications**
2. **Non-safety related applications.**

To achieve safety related applications, Dedicated Short Range Communications (DSRC) [3], [6] protocol requires each vehicle in VANETs broadcast a traffic related message every 100–300 ms. The message includes a vehicle’s instant driving status information, such as location, speed, turning intention, and driving status (e.g., regular driving, waiting for a traffic light, traffic jam, etc.). Facilitated by these messages, vehicles can be aware of their neighboring vehicles’ driving behavior in real time. Therefore potential collisions or accidents can be alerted and might be avoided under the assistance of warning messages sent from other vehicles.

VANETs also provide us many promising non-safety related applications. The first is Location Based Service (LBS) [6]. Vehicles on the road may send RSUs a request asking the closest location information, such as the closest gas station, shopping center, coffee shop, etc. RSUs that connect with a location server respond vehicles with the related location information. The second is traffic management. RSUs that are pervasively located in a city can real-time collect and monitor traffic flow information, which can be used to assist us in predicting traffic congestion and controlling traffic signals.

The third is Internet access providing. Vehicles can download/upload data information such as mp3/email through RSUs. In addition, a VANET can also be used as a vehicle-based Delay Tolerant Networks (DTN), which takes advantage of RSUs and vehicles to buffer and distribute data information.

IV. Related Work

Sun et al. in [1] proposed a cost efficient RSUs deployment scheme to guarantee that OBUs at any place could communicate with RSUs in certain driving time (DT), and the extra overhead time (ET). They have formalized the DT and ET constraints for certificate updating and presented a scheme to achieve the most cost-efficient deployment of RSUs.

Lochert et al. in [2] have introduce an approach for optimizing the placement of genetic algorithms based VANET-based traffic information system which can overcome the two key problems of strictly limited bandwidth and minimal initial deployment. They presented a domain specific aggregation scheme in order to minimize required overall bandwidth. A genetic algorithm is proposed to identify good positions for static RSUs in order to cope up with the highly partitioned nature of a VANET in an early deployment stage. A tailored tool chain allows optimizing the placement with respect to an application-centric objective function, based on travel time savings.

Dhamgaye et al. in [3] has addressed to the difficulty faced in designing an efficient routing protocol for VANET, because of the vulnerability of wireless medium to attacks. This survey paper gives brief overview of different routing protocols depending on the availability, authentication, confidentiality, privacy, non repudiation and data trust. Also attempt has been made to identify major security issues and challenges associated with different routing protocols.

Gayathri Chandrasekaran in [4] has discussed about the popularity of VANETs that they would turn out to be THE networking infrastructure for supporting future vehicular applications. The paper includes the factors that are critical in deciding the networking framework over which the future vehicular applications would be deployed. Paper also contains the discussion about the counter claims that challenged the practicality of VANETs. But it shows inspite of that still there are strong reasons for active research efforts towards making VANETs a reality in the near future.

Samara et al. in [5] has addressed the VANETs as fertile region for attackers, who will try to challenge the network with their malicious attacks. This paper gave a wide analysis for the current challenges and solutions, made critics for these solutions and proposed suitable solutions for some of these problems. They have also proposed new solutions that will help to maintain a securer VANET network.

Liang et al. in [8] has proposed a novel optimization framework for RSU deployment and configuration in a vehicular network. They formulated the problem of placement of RSUs and selecting their configurations (e.g. Power level, types of antenna and wired /wireless back haul network connectivity) as a linear program. The objective function is to minimize the total cost to deploy and maintain the network of RSU’s.

A user specified constraint on the minimum coverage provided by the RSU is also incorporated into the optimization framework. Further, the framework also supports the option of specifying selected regions of higher importance such as locations of frequently occurring accidents and incorporating constraints requiring stricter coverage in those areas.

Yi Qian, and Nader Moayeri in [9] has elaborated that the main benefit of VANET communication is seen in active safety systems that increase passenger safety by exchanging warning messages between vehicles. In this paper they have proposed a secure and application-oriented network design framework for VANETs. Both security requirements of the communications and other requirements of potential VANET applications and services have been considered. The proposed framework consists of two basic components: an application-aware control scheme and a unified routing scheme. This study provides a guideline for the design of a more secure and practical VANET.

Lee et al. in [10] has addressed the optimal placement of RSUs to improve connectivity. Each intersection is considered as a potential RSU location. These potential locations are then ordered based on number of vehicle-reports received within communication range of each RSU. The placement scheme only considers taxi location reports and does not consider speed or density of all vehicles.

V. Conclusion

This paper has presented a literature review on optimistic road side unit deployment in VANETs. It is shown that the deploying towers are a critical issue as we have to cover more and more area to optimistically deploy RSUs. As RSUs cost is too high so we are unable to deploy more and more RSUs, so optimistic deployment or RSUs is still a hot are of research.

In this work, more emphasis is on the existing techniques of optimally deploy RSUs. But there are great number of issues in VANETs e.g. road side accidents, traffic jams, speed control, free passage of emergency vehicles and unseen obstacles and several other factors like the type of the road, daytime, weather, traffic density etc. which can be considered in future. Actual field experiments to study the deployment of RSUs in various road conditions with actual network layers can provide significant insights.

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