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## The Dynamic Counting Broadcast in Vehicular Networks

Mrs.P.Sathyasutha, M.E<sup>1</sup>, Ms. G.Yogeswari<sup>2</sup>

Assistant Professor, Department of Computer Science, Gnanamani College of Engineering, Tamilnadu, India<sup>1</sup>

PG Scholar, Department of Computer Science, Gnanamani College of Engineering, Tamilnadu, India<sup>2</sup>

**ABSTRACT:** An interesting application of wireless MANETs that is emerging with a high potential for research and development is the inter-vehicle communication where nodes collect and distribute traffic information while moving in urban areas. Broadcasting is a key component to vehicular communication with the aim of high coverage and low medium consumption. Existing broadcasting schemes, however, result in redundancy and medium contention. In this paper a broadcasting scheme with intelligent neighbourhood sensing is produced and tested in two Vehicle Ad Hoc Network (VANET) contexts. Simulation results show that our scheme reduces the amount of unneeded transmissions through the medium even under high density with high traffic loads while maintaining comparable network coverage. (Vehicle Ad Hoc Network) (VANETs) is broadcasting: the use of wireless communication for sharing information among vehicles, or between vehicles and infrastructure. Dozens of broadcast protocols have been developed in recent years, including protocols for 1-hop broadcasting of vehicle status information (beaconing) and for geocasting-based applications. However, most of these protocols were designed for one application and cannot co-exist, nor can one broadcast solution meet the demands of all applications. These observations motivated our effort to develop a holistic Network layer for (Vehicle Ad Hoc Network) VANETs. We identify the need for making (Vehicle Ad Hoc Network) VANET broadcast context-aware, and for supporting four different classes of broadcast protocols, each with its own properties. These classes are not only able to co-exist on the same Network layer, but also to complement one another's functionality. Thus, large applications as well as more holistic Transport protocols can be designed by combining two or more broadcast classes. We discuss the specific characteristics of these classes and design candidate protocols for each class.

**KEYWORDS:** VANET, Broadcast, Vehicular Networking, Information Dissemination, Protocol Design.

### 1. INTRODUCTION

Vehicular Ad hoc NET works (VANETs) emerged from ideas explored in initiatives such as the Intelligent Vehicle/ Highway Systems (IVHS) and is a vital part of what is referred to nowadays as the Intelligent Transportation System (ITS) with initiatives from Japan, America and Europe . VANETs are a special kind of MANETs primarily deployed with ideas of transport efficiency and traffic safety in mind. VANET wireless connectivity patterns include: vehicle-to-vehicle (ad hoc), vehicle to infrastructure (cellular network and WLAN) and among vehicles (hybrid). The distinctive characteristic of VANETs is the highly changeable topology with no central coordination, where network nodes move at potentially high speeds in constrained paths within a built-up area potentially resulting in frequent network partitions leading to immense connectivity issues.

We propose a new intersection-based geographical routing protocol for multi-hop data routing in vehicular networks for city roads. At intersections, nodes use both local traffic information in different roads and angle of roads aiming to find most reliable and efficient route for the given packet. Unlike most of the geographical routing protocols, our protocol does not need a digital map to find intersections. Instead, it develops a method using which each node dynamically detects whether it is at an intersection. This makes the TIGeR protocol also usable for places for which a digital map is not available.

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## II. RELATED WORK

It is important to employ a VANET communication mechanism that addresses its main characteristics satisfying mentioned topological challenges. VANET wireless communication is carried out conventionally by broadcasting or flooding. Broadcasting is a basic communication element used for discovering neighbours, collecting global information, naming, addressing; and route discovery and maintenance for many routing protocols. Broadcasting guarantees coverage but at the penalty of medium saturation caused by redundant transmissions. In an effort to minimize the disruptive effect of broadcasting researchers proposed several models in the MANET context. Those are stochastic and deterministic. In deterministic schemes, a transmitting node predetermines its forwarding nodes before the broadcast. However, this incurs a large overhead in terms of time and message complexity for building and maintaining a fixed backbone. Deterministic schemes should be avoided in VANET context as high mobility incurs massive topological changes that are expensive to maintain. Stochastic schemes, in contrast, rebuild a backbone from scratch during each broadcast. Nodes make instantaneous local decisions about whether to broadcast a message or not using information derived only from overheard broadcast messages.

1. Vehicle trajectory as the moving path from the vehicle's starting position to its destination position in a road network;
2. Expected Delivery Delay (EDD) as the expected time taken to deliver a packet generated by a vehicle to an Internet access point via the VANET
3. Carry delay as a part of the delivery delay introduced While a packet is carried by a moving vehicle;
4. Communication delay as a part of the delivery delay Introduced while a packet is forwarded among vehicles.

Vehicles are installed with a GPS-based navigation system and digital road maps. Traffic statistics, such as vehicle arrival rate  $\lambda$  and average vehicle speed  $v$  per road segment, are available via a commercial navigation service, similar to the one currently provided by Garmin Traffic [1]. Vehicles know their trajectory by themselves. However, vehicles do not release their trajectory to other vehicles for privacy concerns. It should be noted that in the VANET scenarios, The carry delay is several orders-of-magnitude longer than the communication delay. For example, a vehicle takes 90 seconds to travel along a road segment of 1 mile with a speed of 40 MPH, however, it takes only ten of milliseconds' to forward a packet over the same road segment, even after considering the retransmission due to wireless link noise or packet collision. Thus, since the carry delay is the dominating part of the total delivery delay, in the rest of the paper, we focus on the carry delay for the sake of clarity, although the small communication delay does exist in our design.

## III. METHODOLOGIES

Neighborhood information is the underlying basis for routing, clustering, and message dissemination in mobile ad hoc networks. Yet, for highly dynamic topologies, this still constitutes a fundamental research problem, particularly if 2-hop neighbor information are needed. This particularly holds for highly dynamic wireless networks like VANET, where protocols need to maintain as accurate as possible 1-hop or 2-hop neighbor information.

### GENERALIZED PROTOCOLS

Many generalized protocol stacks focus on a single application domain, cooperative awareness, but make the underlying broadcast protocol also available for other applications. For this, Cooperative Awareness Messages (CAMs), also known as Basic Safety Messages (BSMs), are broadcast at fixed intervals, usually in the range of 0.1–1 s, a procedure also known as beaconing. Since the communication in VANETs is not sufficiently reliable, approaches that increase reliability while minimizing the number of beacon retransmissions have been investigated [16]. The main challenge, which holds for all classes of broadcast based protocols, is that the frequency of possible broadcasts strongly depends on the available capacity of the wireless channel. Thus, the protocol must be able to prevent broadcast storms.

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To this end, adaptive beaconing solutions that focus on congestion control have been developed. Later on, fairness as a primary objective was integrated with these adaptive solutions [20].

Bloom filters [27] have been investigated for network applications [28]–[31] to address congestion on the wireless channel besides the already mentioned adaptive beaconing solutions. However, these approaches target very specific application scenarios and did not focus on generic neighborhood management, which is very important for VANETs. A first approach towards 2-hop neighbor information dissemination using Bloom filters has been presented very recently [32]. However, this approach uses the intersection of several Bloom filters, which increases the false positive error probability, thus causing loss of information.

In comparison with traditional approaches not using Bloom filters the presented work reveals that the beacon overhead could be decreased but on the application layer no substantial performance gain can be achieved. Geocasting goes one step beyond simple 1-hop broadcasting. It combines broadcast with geographical knowledge, and fulfills many additional application requirements. More recent protocol designs combine geocasting with Delay Tolerant Networking (DTN) capabilities and exploit estimated vehicle trajectory.

## APPLICATION-SPECIFIC PROTOCOLS

Application-specific protocols have been investigated in a whole spectrum of potential applications, of which we choose several examples to illustrate the requirements of the selected approaches. We start again with cooperative awareness. This application also relies on multi-hop broadcasting in order to counter the substantial radio signal shadowing that occurs in urban environments. A reliable broadcast protocol that touches on this problem is published in [33], and the use of parked vehicles to increase reliability has been proposed in [34].

Another application is Cooperative Adaptive Cruise Control (CACC), or platooning. This application has possibly the tightest real-time requirements for maintaining cruise control. Broadcast based communication protocols have been designed for this application. These protocols require a dedicated radio channel for operation.

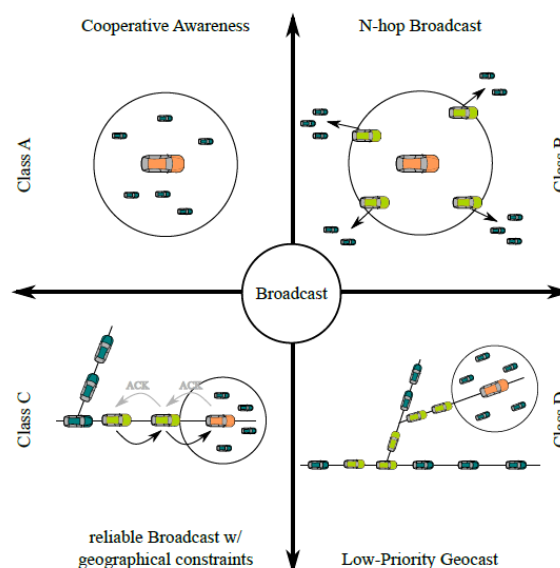


Fig.1 our vision of VANET broadcast classes

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## IV. NETWORK APPLICATIONS OF BLOOM FILTERS

A Bloom filter is a simple space-efficient randomized data structure for representing a set in order to support membership queries. Bloom filters allow false positives but the space savings often outweigh this drawback when the probability of an error is controlled. Bloom filters have been used in database applications since the 1970s, but only in recent years have they become popular in the networking literature. The aim of this paper is to survey the ways in which Bloom filters have been used and modified in a variety of network problems, with the aim of providing a unified mathematical and practical framework for understanding them and stimulating their use in future applications. A Bloom filter is a simple space-efficient randomized data structure for representing a set in order to support membership queries. Bloom filters allow false positives but the space savings often outweigh this drawback when the probability of an error is made sufficiently low. Burton Bloom introduced Bloom filters in the 1970s [Bloom 70], and ever since they have been very popular in database applications.

## V. CONCLUSION AND FUTURE WORK

### CONCLUSION

With the increasing popularity of vehicular Ad-Hoc networking, we believe that our forwarding scheme opens the first door for exploiting the potential benefit of the vehicle trajectory for the performance of VANET networking. As a future work, we will develop a data forwarding scheme from stationary nodes (i.e., Internet access points) to moving vehicles for supporting the Infrastructure-to-Vehicle data delivery in vehicular networks. This reverse forwarding to moving vehicles is needed to deliver the road condition information such as the bumps and holes for the driving safety. However, this reverse data forwarding is a more challenging problem because we need to consider both the destination vehicle's mobility and the packet delivery delay

### FUTURE WORK

Future implementation will investigate the impact of data traffic volume on the trajectory-based data forwarding in light-traffic vehicular networks and develop a data forwarding scheme considering the data traffic volume, the vehicle trajectory, and the vehicle contact time for communications along the road segment.

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