Introduction

Many Driver Support Systems in future vehicles will rely on wireless communication. This wireless communication can be divided into two categories: Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I). V2V is often used for vehicles to exchange information of a local nature, e.g. co-operative following or collision avoidance. V2I can be used as ‘smart road signs’, access to back-end networks (e.g. Internet) or as simple repeaters. The term VANET is key to V2V and V2I communication: Vehicular Ad hoc Network.

A Driver Support System described in [1] presents an interesting problem: a vehicle should be aware of the state of traffic on a road, up to several kilometers ahead. A system called the TrafficFilter has been proposed in [2] to provide this information. In summary, the TrafficFilter uses multi-hop V2V communication to disseminate information over distances of several kilometers. This information is expressed in a structure called a TrafficMap. The TrafficMap consists of entries which are sampled representations of the local traffic flow speed, shown in Fig. (a). These samples are produced in a fashion similar to Run-length Encoding.

The over-the-horizon awareness is disseminated by flooding a TrafficMap against the flow of traffic. Every vehicle which receives the information does three things: 1) supply the received information to its Driver Support Systems, 2) decide whether it needs to add a sample to the TrafficMap and finally 3) decide if it needs to partake in the dissemination of the TrafficMap.

The exact functioning of steps 1) and 2) has been described in detail in [2] and [3]. Step 3) is performed by a flooding scheme.
2 The Flooding Scheme

Flooding is notorious for the effects of the Broadcast Storm problem. This phenomenon has been described in [4] and [5], and countermeasures in the form of broadcast suppression techniques are proposed. These are flooding schemes where not every node, but only a select few rebroadcast.

The Slotted 1-Persistence flooding described in [5] was analysed in [2] and found to exhibit an increasing delay and decreasing delivery ratio as the number of vehicles in communication range increases, as shown in Figs (c) and (d). We provided a solution in [2], called microSlotted 1-Persistence flooding. This scheme is based on the Slotted scheme, and adds a small additional delay to break what is known as timeslot boundary synchronisation [6].

Upon reception of a message, every node $i$ compares its position to that of the node transmitting the message ($j$), in order to calculate a wait time $T_{\text{wait}}$, as illustrated in Fig. (b). Nodes further removed from the transmitter choose earlier slots and hence shorter wait time. If $T_{\text{wait}}$ has passed without reception of a retransmission by another node, the node will transmit. $T_{\text{wait}}$ is defined as:

$$T_{\text{wait}} = T_{\text{sij}} + T_{\text{msij}}$$

Where $T_{\text{sij}} = S_{ij} \cdot t_s$ and $T_{\text{msij}} = M S_{ij} \cdot t_{ms}$. This assigns a wait time based on a slot allocation criterion ($S_{ij}$ and $MS_{ij}$ respectively) multiplied by the duration of a slot.

The parameter $t_s$ is the duration of a slot, chosen such that a transmission executed in a slot can be received by all nodes in range. The parameter $t_{ms}$ is the duration of a microSlot, taken as an IEEE 802.11 DIFS.

In the same line of reasoning, a node selects a microSlot. For this, the geographical size of a slot is divided into ten microSlots. As with assigning $S_{ij}$, when the distance between $i$ and $j$ is larger, $MS_{ij}$ will be smaller.

Node $i$ will schedule to hand the message over to the MAC layer after $T_{\text{wait}}$ has passed without reception of retransmissions by other nodes.

3 Conclusions and Future Work

An extensive comparison of the Slotted and microSlotted flooding schemes is performed in [2]. Figs. (c) and (d) show the results of simulation experiments. A large degree of collisions in the Slotted scheme causes limited propagation of the flood; a decreasing percentage travels the entire 10km road while the microSlotted scheme maintains high reachability. The collisions also cause delay to increase: a transmission in a slot collides and a node in a later slot will have to perform the retransmit. Delay increases at a slower rate for the microSlotted scheme as the vehicle density rises.

A journal paper describing and evaluating the complete TrafficFilter system is underway.
6.2 Comparing the two Flooding Strategies

\[ 0 \times 1 \times DIFS = 2.61 \text{ms} \] whereas the overall delay is in the order of 100ms.

An IEEE 802.11p DIFS is 5.8 \( \mu s \) \[49\]

Chapter 6. Evaluation of the System

With microSlots, collisions in the first slot are unlikely because there is less

\[ 1 \text{km} = 50 \text{m} \], equal to the slot size


References