Geo-aware, mobility-aware publish-subscribe system for a traffic warning system

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Introduction

Total number of vehicle sales in the united states is averaged 15.43 millions from 1993 until 2015. Last year had a surge in the sales which accounted to 17.76 millions and is expected to rise with the boosting economy[2]. This also concerns us about the road safety with new vehicles coming in. A total of 32,675 people died in motor vehicle crashes in 2014[1] with a huge number of causalities. We can take help of the new technology advances to mitigate this and ensure safe journey. This paper is aimed at using the state-of-art 5G networks to pass on the information to the mobile vehicles about the events of their interest in the surroundings and help them in taking decisions prior.

The setting in which this system works needs communication to be happened at a faster pace and the latency caused by present networks is not permissible. Though, there are architecture [3]that use 802.11P communication paradigm for low latency, they inherently don't have any trust mechanisms and the adhoc networks in here are frequently modified or newly created which is an overhead. mobile networks provide us the advantage in this direction as they are inherently secure.

Design

Our architecture can be broadly distinguished into two types: 1) The publish/subscribe system , this is the model of distributing messages between the mobile vehicles. 2) The communication network which binds the vehicles to the pub/sub system. The requirements for the pub/sub system where gathered from looking at the space in which it is operating. They are: 1) Any vehicle can publish/subscribe for the information. 2) Subscriptions are based up on events and their frequency. 3) One of the major requirement that many present pub/sub systems don't solve is the mobility of publishers, subscribers. In our system this is a key point to be considered. We want the subscribers to get the information even if they are temporarily disconnected to the network or they connect to the network through an another eNodeB.

They way our proposed system works is: Every interested subscriber will subscribe to an event(examples of events are:a moving animal, an accident). The subscriber can also request to be notified about an event if it has passed a certain threshold.(i.e, notify me about an event only if 10 other vehicles also published the same info). Once an event has occurred the publishers use the mobile networks to send the information to the enodeB where the pub/sub system resides. The system looks at the event and then finds the area of interest(AOI). AOI is the neighborhood to which we want to send the notifications. The determination of the AOI depends upon the event type(If

an accident has occured on one side of the road the AOI could be only the area behind the vehicle that has published the event and specifically which are headed to this site. In case of a moving animal the AOI could be in all directions). Once the AOI is determined we extract the list of all the vehicles in the AOI and look at their subscriptions. If a subscription matches we use the mobile network to push the information to that vehicle. If a vehicle has moved from an enodeB to another. It will inform the new enodeB about its movement from the old enodeB and it's subscriptions. Now, the two pub/sub systems sitting on the enodeBs communicate to figure out if there are any events that happened while transition of the vehicle. In that case they are downloaded to this new system and are pumped out to the moved vehicle.

References

[1] Insurance Institute for Highway Safety, `http://www.iihs.org/iihs/topics/t/general-statistics/fatalityfacts/overview-of-fatality-facts`

[2] Trading Economics, `http://www.tradingeconomics.com/united-states/total-vehicle-sales`

[3] Multi-Hop Cluster based IEEE 802.11p and LTE Hybrid Architecture for VANET Safety Message Dissemination, `https://arxiv.org/abs/1603.05628`