Car to Car communication protocol issues
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Abstract: Vehicular Ad hoc Networks (VANETs) is the wireless networking concept of the wireless ad hoc networks in the research community. Vehicle-to-Vehicle (V2V) communication plays a significant role in providing a high level of safety and convenience to drivers and passengers. Vehicular networking has significant potential to enable diverse applications associated with traffic safety, traffic efficiency and infotainment. In this, I introduce the basic characteristics of vehicular networks, an overview of applications and associated requirements, along with issues and the proposed solution. About 60% roadway collisions could be avoided if the operator of the vehicle was provided warning at least one-half second prior to a collision, which provide an important test-case for enhanced collision avoidance approaches based on v2v wireless communications. In this work, we propose and study the impact of a IEEE 802.11p protocol that propagates an emergency warning message (EWM) down a platoon of cars on a highway. The design objective is to ensure reception of this message with stringent (low) delay constraints so as to provide drivers with requisite available maneuver time (AMT) to avoid rear-end collision and design of effective protocol comprising congestion control policies, service differentiation mechanisms and methods for emergency warning dissemination. Simulation results demonstrate that the proposed protocol achieves low latency in delivering emergency warnings and efficient bandwidth usage in stressful road scenarios.

Key Words: Car to Car communication protocol (C2C)

1. INTRODUCTION
A Vehicular Ad-Hoc Network (VANET) is a form of Mobile ad-hoc network (MANET), to provide communications among nearby vehicles and between vehicles and nearby fixed equipment, usually described as roadside equipment.

1.1 Vanet
A Vehicular Ad-Hoc Network or VANET is a technology that uses moving vehicles as nodes in a network to create a mobile network. VANET turns every participating vehicle into a wireless router or node, allowing vehicles approximately 100 to 300 meters of each other to connect and, in turn, create a network with a wide range.

The Dedicated Short-Range Communication (DSRC) allocates 75MHz (5.850 - 5.925 GHz) in the 5.9GHz band and offers the potential to effectively support vehicle-to-vehicle and vehicle-to-roadside safety communications. DSRC enables a new class of communication applications that will increase the overall safety and efficiency of the transportation system. The driving force behind the creation of DSRC is the need to improve the safety of the roads and rich media content delivery are enabled using low-cost commodity radios.

One way to improve safety is to alert drivers of dangerous situations before they are able to observe them. Intelligent Transportation Systems (ITS) are the future of transportation. As a result of emerging standards, vehicles are talk to one another as well as their environment.
Traffic accidents have been taking thousands of lives each year, outnumbering any deadly diseases or natural disasters. The road traffic crashes, which result in the grief and suffering, contribute to economic losses to victims, their families, and nations as a whole. India suffers from the highest number of deaths - around 1, 05,000 in absolute terms annually- due to road accidents in the India. Studies show that about 60% roadway collisions could be avoided if the operator of the vehicle was provided warning at least one-half second prior to a collision.

1.2 Characteristics of VANET
- Highly Dynamic topology
- Frequent disconnected Network:
- Mobility Modeling and Prediction:
- Communication Environment
- Hard Delay Constraints
- Interaction with onboard sensors
1.3 Applications

Vehicular networking applications can be classified as 1) Active road safety applications, 2) Traffic efficiency and management applications and 3) Infotainment applications.

1) Active road safety applications:

Active road safety applications are those that are primarily employed to decrease the probability of traffic accidents and the loss of life of the occupants of vehicles.

Active road safety applications primarily provide information and assistance to drivers to avoid collisions with other vehicles. Such information can represent vehicle position, intersection position, speed and distance heading.

Some examples of active road safety applications are given below:
Intersection collision warning, Lane change assistance, Overtaking vehicle warning, Head on collision warning, Rear-end collision warning, Co-operative forward collision warning, Stationary vehicle warning, Traffic condition warning, Hazardous location notification, Control Loss Warning Etc.

2) Traffic efficiency and management applications:

Traffic efficiency and management applications focus on improving the vehicle traffic flow, traffic coordination and traffic assistance and provide updated local information.

a) Speed management: Speed management applications aim to assist the driver to manage the speed of his/her vehicle for smooth driving and to avoid unnecessary stopping.

b) Co-operative navigation: This type of applications is used to increase the traffic efficiency by managing the navigation of vehicles through cooperation among vehicles and through cooperation between vehicles and road side units.

3) Infotainment Applications:

a) Co-operative local services: This type of applications focus on infotainment that can be obtained from locally based services such as point of interest notification, local electronic commerce and media downloading.

b) Global Internet services: Focus is on data that can be obtained from global Internet services. Typical examples are insurance, financial services, parking zone management etc.

1.4 Communication Types

Connecting vehicles to each other and with the infrastructure allows them to share and exchange information and sensor data among each other and among them and the infrastructure (e.g. for entertainment, diagnostics, safety, probe data collection, wireless payments, toll collection in the U.S.).

The communication types in VANET are classified into following types.

- Vehicle to Vehicle (V2V)
- Vehicle to Infrastructure (V2I)
- Vehicle to Roadside (V2R)
1.4.1 Vehicle to Vehicle (V2V) (Zero Infrastructure, Purely Ad-Hoc)

V2V (vehicle-to-vehicle) is a technology designed to allow vehicles to serve as data sensors and anonymously transmit traffic and road condition information from every major road within the transportation network. Vehicles can communicate to each other in the rage of 100m to 1000m and allowed to “talk” to each other without any infrastructure. V2V communication approach is most suited for short range vehicular networks.

1.4.2 Vehicle to Infrastructure / Roadside Communication (V2I/V2R)

V2I (vehicle-to-infrastructure) is the direct wireless exchange of information between vehicles and the fixed infrastructure. Vehicle to Infrastructure provides solution to longer-range vehicular networks. It makes use of preexisting network infrastructure such as wireless access points Road-Side Units (RSU). Communications between vehicles and RSUs are supported by Vehicle-to-Infrastructure (V2I) protocol and Vehicle-to-Roadside (V2R) protocol. The Roadside infrastructure involves additional installation costs. The V2I infrastructure needs to leverage on its large area coverage and needs more feature enhancements for Vehicle Applications.

2. PROPOSED SYSTEM

2.1 Statement


2.2 Objective

Emerging wireless technologies for vehicle-to-vehicle (V2V) and vehicle-to-roadside (V2R) communications such as DSRC are promising to dramatically reduce the number of fatal roadway accidents by providing early warnings. Issues in this problem statement are solved are congestion control, service differentiation and methods for emergency warning dissemination. Simulation results demonstrate that the proposed protocol achieves low latency in delivering emergency warnings and efficient bandwidth usage in stressful road scenarios.
2.3 Scenario

Traffic accidents have been taking thousands of lives each year, which are more than any deadly diseases or natural disasters. About 60% roadway collisions could be avoided if the operator of the vehicle was provided warning at least one-half second prior to a collision.

Human drivers suffer from perception limitations on roadway emergency events, resulting in large delay in propagating emergency warnings, as the following simplified example illustrates. In Figure 1, three vehicles, namely A, B and C, travel in the same lane. When A suddenly brakes abruptly, both vehicles B and C are endangered, and being further away from A does not make vehicle C any safer than B due to the following two reasons:

a) Line-of-sight limitation of brake light: Typically, a driver can only see the brake light from the vehicle directly in front. Thus, very likely vehicle C will not know the emergency at A until B brakes.

b) Large processing/forwarding delay for emergency events: Driver reaction time, i.e., from seeing the brake light of A to stepping on the brake for the driver of vehicle B, typically ranges from 0.7 seconds to 1.5 seconds, which results in large delay in propagating the emergency warning.

3. PROTOCOL ARCHITECTURE

3.1 Dedicated Short-Range Communication (DSRC)

A number of technologies are used in vehicular networks that are necessary for broadcast transmissions. The DSRC physical layer description is channel assignment and control channel access for DSRC. The IEEE 802.11 MAC protocol contains the distributed coordination function (DCF).

3.1.1 DSRC Physical Layer

The physical layer of the network protocol stack is responsible for placing raw bits on to channel. This section describes the physical layer of DSRC, channel assignment of DSRC.

3.1.1.1 Channel Assignment

The FCC allocated 75 MHz of the radio spectrum for DSRC. The 5.9 GHz DSRC spectrum is composed of six service channels that are 10 MHz each. Also, one 10 MHz control channel exists.

![DSRC Channels](image)
Above figure provides the channel layout for DSRC. The data rates possible for the 10 MHz channels are 6, 9, 12, 18, 24, and 27 Mb/s. The modulation scheme used by DSRC is Orthogonal Frequency Division Multiplexing (OFDM). In addition, DSRC doubles the guard period in comparison to 802.11a. The modified version of 802.11a, used for DSRC, is known as 802.11p. The following list contains the channels of DSRC and the type of applications that are supported by the channel.

• Channel 172 is reserved for medium power safety applications.
• Channel 174 is reserved for medium power applications that are shared by all.
• Channel 175 is a combination of channels 174 and 176.
• Channel 176 is reserved for medium power applications that are shared by all.

*Channel 178 is the control channel* it supports all power levels, safety application broadcasts, service announcements, and vehicle-to-vehicle broadcasts messages.

• Channel 180 is reserved for low power configurations and provides little interference when units are separated by 50 ft or more.
• Channel 181 is a combination of channels 180 and 182.
• Channel 182 is reserved for low power configurations.
• Channel 184 is reserved for a high power service channel that is used to coordinate intersection applications.

3.1.1.2 Control Channel Access

Channel 178 is reserved for the control channel. The control channel is the most important channel of DSRC, and the efficient use of this channel is critical. Each OBU monitors the control channel for both safety messages and service channel announcements. The control is monitored by each vehicle and RSU.

The FCC recommends that the control channel is used for messages that take less than 200 μs to transmit. If the communication last longer than 200 μs another channel must be used. *Vehicles must periodically switch to the control channel to receive safety messages.* A requirement of DSRC is that all vehicles must switch to the control channel every 100 ms and remain on the channel for a minimum amount of time. The reason vehicles switch to the control channel, every 100 ms, is to receive safety messages from the surrounding vehicles. To guarantee that safety messages are not sent before a vehicle switches to the control channel. The control channel coordination allows a vehicle to correctly receive safety messages and also use the available services in the network.

4. IMPLEMENTATION

Each vehicle on the highway is assumed to be equipped with a positioning device (e.g. Global Positioning System) and an IEEE 802.11 radio working in ad hoc mode. Vehicles cruising in one lane have identical velocity and knowledge of their lane ID. There are multiple lanes, but we assume no lane changing during the EWM propagation. When an emergency event occurs, the affected vehicle broadcasts an EWM to inform all subsequent peers.

The warning message contains the sender’s position, lane ID, event ID, event location, event time stamp, and message lifetime. Upon receiving such a EWM, the trailing vehicles inform their drivers of the potential hazard through an audio or visual signal. In such a way, drivers become aware of the emergency situations before they see the braking light of the lead vehicle. We further assume that all vehicles, upon receiving the EWM, start to decelerate after a pre-defined driver’s perception response time.
4.1 Algorithm:
This simulation is implemented in ns-2 simulator.
Step 1: Define options for Ad-hoc network
Step 2: Create Simulator, trace file and namfile.
   set ns [new Simulator]
   set tracefd [open tracef.tr w]
   set namtrace [open namf.nam w]
Step 3: Configure the node by setting various options.
Step 4: Create the nm nodes
   set node_($i) [$ns node]
Step 5: provide initial location to the mobile nodes
Step 6: Generates the Movements by giving starting time destination points with speed
   $ns at 0.5 "$node_(0) setdest 300.0 50.0 5.0"
   $ns at 1.0 "$node_(1) setdest 270.0 50.0 7.0"
Step 7: Setting a TCP connection between the nodes in the Simulation
Step 8: Giving instructions to node where Simulation ends.
Step 9: run the simulation
   $ns run
Step 10: Stop.

4.2 Flow Chart:

Figure4: Flow chart
4.3 Activity Diagram:

![Activity Diagram](image)

Figure5: Activity Diagram

4.4 Sequence Diagram:

![Sequence Diagram](image)

Figure6: Sequence Diagram
5. CONCLUSION

In this paper, we have discussed the importance and challenges of using v2v wireless communication for vehicle safety applications. A stringent EWM delay constraint is identified as the key metric for protocol design. An integrated rear-end avoidance protocol is presented, which is based on 802.11 MAC and multi-hop broadcast. With appropriate EWM broadcast power, more than 70% of vehicles are free of rear-end collisions, even in the dense multiple lane scenario plus the worst case visibility assumption.

6. REFERENCES


