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A Review on Vehicle-To-Vehicle Communication Protocols For Traffic Safety Using Co-Operative Collision Warning

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Abstract: Vehicular ad hoc network (VANET), a part of mobile ad hoc networks (MANETs), is a capable method for smart transportation organisation. It has no fixed setup and instead relies on the vehicles themselves to deliver network functionality. Still, due to mobility constraints, driver performance, and high mobility, VANETs rally on characteristics that are melodramatically different from many nonspecific MANETs. In VANET communication can be classified into two ways (i) vehicle-to-vehicle (ii) vehicle-to-roadside unit. This paper gives a review on various communication protocols used in VANET to achieve low latency in delivering warning messages. A Vehicle-to-Vehicle communication protocol for cooperative collision threatening encompasses of mobbing control policies, service differentiation mechanisms and approaches for emergency warning dissemination. An overview provides the concept of Cooperative Collision Avoidance (CCA), Medium Access Control (MAC) and the routing layer and in Joint vehicle-vehicle/vehicle-roadside communication protocol emergency warning messages are simultaneously transmitted through Vehicle-to-Vehicle (V2V) and Vehicle-to-Roadside (V2R) communications in order to achieve multipath diversity routing. In addition, to improve further communication reliability and achieve low latency, a Multi-Channel (MC) technique based on two non-overlapping channels for Vehicle-Vehicle (V2V) and V2R (or R2V) have been proposed.

Keywords: Cooperative collision, collision avoidance, communication protocols, vehicle-to-vehicle, vehicle-to-roadside.

I. INTRODUCTION

Equipment which uses moving cars as nodes in a network to create a mobile network is called as a Vehicular Ad-Hoc Network. VANET turns every contributing car into a wireless router, letting cars roughly 100 to 300 meters with one another to connect the nodes and, this produce a network with anextensive range. Whenever cars drop out of the signal range and the network, other cars can join in, linking vehicles to one another so that a mobile Internet is created. It is estimated that the first system that will blend this technology are police and fire vehicles to communicate with each other for safety commitments. Recent studies shows that about 60% of roadway accidents could be avoided if the driver was warned just one-half second before the collision occurs. There are different kinds of systems to assist drivers in the roads. Inter-Vehicle Communication (IVC) has attracted research attention from the transport industry of Japan, Europe and US. Traffic accidents have been taking thousands of lives each year, outnumbering any deadly diseases or natural disasters. 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 Band Care endangered, and being further away from A does not make vehicle C any safer than B due to the following two reasons:

- 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.
- 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.

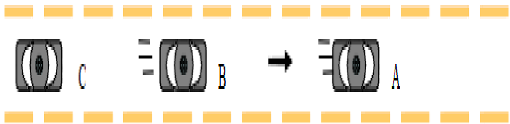

Fig.1. V2V helps improve road safety [2]

Using V2V communication, in the previous example, vehicle A can send warning messages once an emergency event happens. If vehicles B and C can receive these messages with little delay, the drivers can be alerted immediately. In such cases, C has a good chance of avoiding the accident via prompt reactions, and B benefits from such warnings when visibility is poor or when the driver is not paying enough attention to the surroundings. Thus, the vehicle-to-vehicle communication enables the *cooperative collision warning* among vehicles A, B and C. Even though V2V communication may be beneficial, wireless communication is typically unreliable. Many factors, for example, channel fading, packet collisions, and communication obstacles, can prevent messages from being correctly delivered in time. In addition, ad hoc networks formed by nearby vehicles are quite different from traditional ad hoc networks due to high mobility of vehicles.

II. Related Work

Previous research work with regard to V2V communication has focused on three aspects: Medium access control, Message forwarding, and Group management. In [10], Lee *et. al.* propose a wireless token ring MAC protocol (WTRP) for platoon vehicle communication, in which all participating vehicles form a group and drive cooperatively. A slot-reservation MAC protocol, R-ALOHA, for inter-vehicle communication is discussed in [6]. Several slot reservation MAC protocols [7,12] are proposed for the Fleet net Project [8]. The common idea across all these protocols is to dynamically allocate transmission time slots to individual vehicles within a group of vehicles. This requires accurate time synchronization using onboard GPS receivers. Although GPS receivers are becoming more and more common in vehicles, TDMA-based protocols face the following implementation difficulties. Xu*et. al.* discuss a vehicle-to- vehicle Location-Based Broadcast communication protocol, in which each vehicle generates emergency messages at a constant rate [4]. The optimum transmission probability at MAC layer for each message is then identified to reduce the packet collision probability.

Message forwarding can help warning message reach vehicles beyond the radio transmission range. In [9], the authors propose a multi-hop broadcast protocol based on slot reservation MAC. Considering the scenario that not all vehicles will be equipped with wireless transceivers, emergency message forwarding in sparsely connected ad hoc network consisting of highly mobile vehicles is studied in [14]. Motion propertiesof vehicles are exploited in [15] to help with message relay. Two protocols to reduce the amount of forwarding messages were proposed in [16]. When an emergency event occurs, there are usually a group of vehicles affected by the abnormal situation.

In terms of group management, [11] defines so called “proximity group” based on the location and functional aspects of mobile hosts; [13] defines a “peer space”, in which all traffic participants share a common interest; In summary, MAC protocols coordinate channel access among different vehicles; multi-hop forwarding mechanisms extend the reachable region for warning messages; and group management protocols define the group of vehicles that share a common interest.

In order to overcome the above-mentioned difficulties, a novel joint V2V/V2R (R2V) communication protocol has been proposed for highway traffic safety.

- First, V2V and V2R (R2V) communications are incorporated to suppress the impact of the unreliability of the wireless channel by exploiting the multiroute diversity.
- Second, a mechanism similar to Intelligent Broadcast with Implicit Acknowledgement (I-BIA) in [5] is employed to reduce the redundant warning messages and consequently reduce the packet collisions.
- Third, MC techniques are employed to eliminate co channel interference between V2V and V2R (R2V) communications by assigning a different frequency band to each.

III. CO-OPERATIVE COLLECTION AVOIDANCE

The inability of drivers to react in time to emergency situations often creates a potential for chain collisions, in which an initial collision between two vehicles is followed by a series of collisions involving the following vehicles. In emergency situations, a driver typically relies on the tail brake light of the car immediately ahead to decide his or her own braking action. Driver reaction time (the duration between when an event is observed and when the driver actually applies the brake) typically ranges from 0.75 to 1.5 s [2]. As a result, a single emergency event can often lead to a string of secondary crashes, creating a multicar chain accident. Chain collisions can be potentially avoided, or their severity lessened, by reducing the delay between the time of an emergency event and the time at which the vehicles behind are informed about it [3]. One way to provide more time to drivers to react in emergency situations is to develop Intelligent Transportation System applications using emerging wireless communication technology. The primary benefit of such communication will be to allow the emergency information to be propagated among vehicles much quicker than a traditional chain of drivers reacting to the brake lights of vehicles immediately ahead.

The mechanism of CCA is explained using a three-car highway platoon example, as shown in Fig. 2a. In the example, all cars are assumed to cruise initially at a steady speed of 72 mph (32 m/s), and with an inter car spacing (or headway) of 1 s (32 m). As shown in the figure, the driver in car 1 starts to decelerate when he sees the tail brake light of car 0, and the driver in car 2 does so when he sees the brake light of car 1. With an assumed driver’s reaction time of 1.5 s, car 0 gets hit by car 1 at a distance of 120 m, and subsequently, car 1 is hit by car 2. The conclusion from this example is that if drivers react only on visual information, all three cars in the platoon end up in a chain collision.

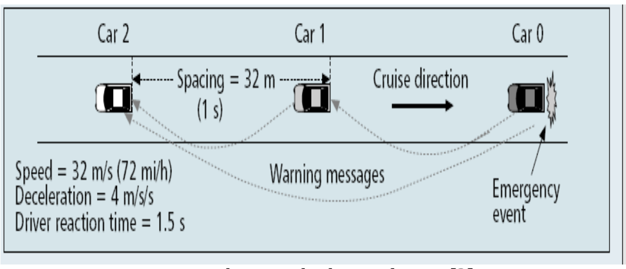

Fig.2a. Three-car highway platoon [3]

In this case, upon meeting the emergency event, car 0 starts sending wireless collision warning messages (W-CWM) to all cars behind it. As shown in Fig. 2a, these messages are forwarded in a multi hop manner in order to ensure a complete coverage within the platoon. Upon reception of a W-CWM, a driver reacts by decelerating, even if the brake light on the car ahead is not already lit.

As shown in Fig.3, car 1 still collides with car 0. However, car 2 can avoid a collision if it receives the W-CWM with sufficiently small delivery latency. For instance, as shown by the Solid line for car 2, with a delivery latency of 0.1 s from car 0 to car 2, car 2 manages to stop without a collision at a distance of 15 m from the site of the emergency event. However, for a delivery latency of 0.4 s (shown by the dotted line for car 2), car 2 cannot avoid the collision as the driver is not given enough time to start decelerating well in advance.

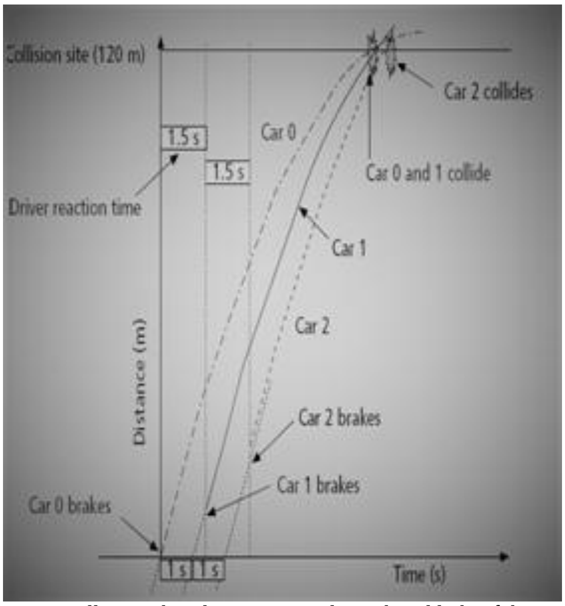

Fig.2b. Chain car collision when drivers react only on thetail light of the car ahead [3]

Two conclusions can be made from the above scenario:

- First, using a high-speed wireless communication network, it is possible to design CCA systems that can improve highway safety by avoiding chain collisions.
- Second, reliable and fast warning message delivery is a crucial requirement for such CCA systems to be able to leverage the underlying networking infrastructure.

IV. METHODS USED IN COMMUNICATION PROTOCOLS

A. Vehicular Collision Warning Communication Protocol

A vehicle can become an abnormal vehicle (AV) due to its own mechanical failure or due to unexpected road hazards. A vehicle can also become an AV by reacting to other AVs nearby. Once an AV resumes it regular movement, the vehicle is said no longer an AV and it returns back to the normal state. In general, the abnormal behaviour of a vehicle can be detected using various sensors within the vehicle. Exactly how normal and abnormal status of vehicles is detected is beyond the scope of this paper. A vehicle controller can automatically monitor the vehicle dynamics and activate the collision warning communication module when it enters an abnormal state has been assumed.

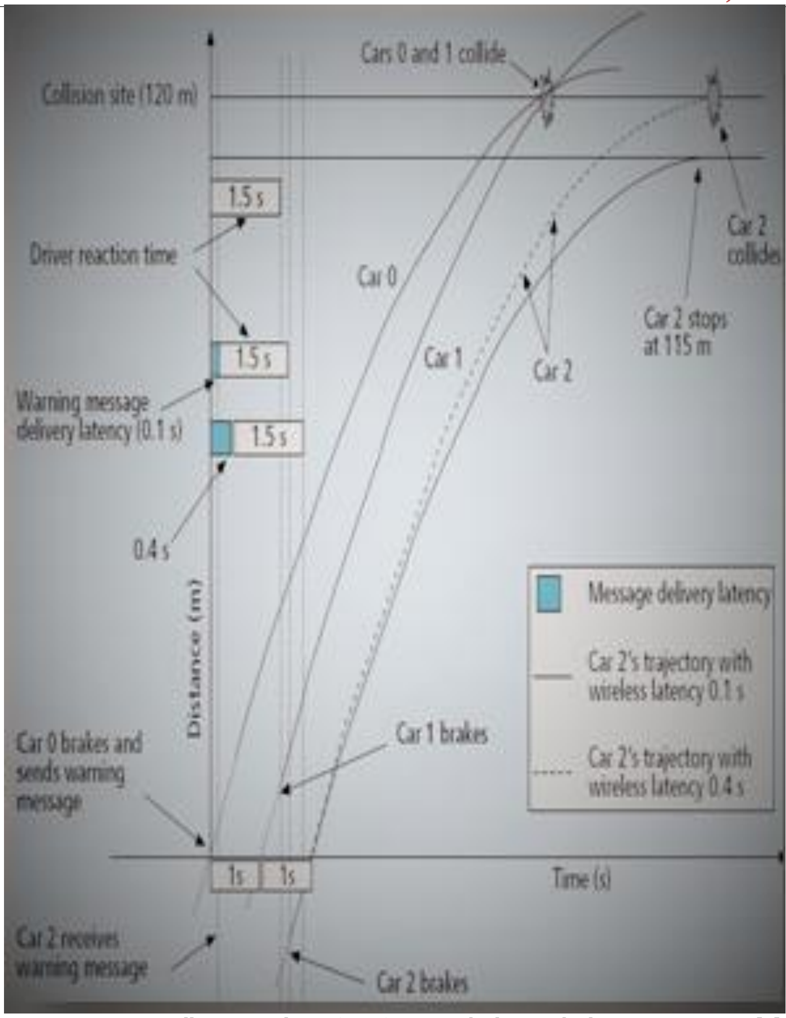

Fig.3.Cooperative collision avoidance (CCA) using vehicle-to-vehicle communications [3]

A vehicle that receives the Emergency Warning Messages (EWMs) can verify the relevancy to the emergency event based on its relative motion to the AV, and give audio or visual warnings/advice to the driver. Each message used in VCWC protocol is intended for a group of receivers, and the group of intended receivers changes fast due to high mobility of vehicles, which necessitate the message transmissions using broadcast instead of unicast. To ensure reliable delivery of emergency warnings over unreliable wireless channel, EWMs need to be repeatedly transmitted.

Conventionally, to achieve network stability, congestion control has been used to adjust the transmission rate based on the channel feedback. If a packet successful goes through, transmission rate is increased; while the rate is decreased if a packet gets lost. Unlike conventional congestion control, here, there is no channel feedback available for the rate adjustment of EWMs due to the broadcast nature of EWM transmissions.

B. Assumptions

The following assumptions have been made for each vehicle participating in the cooperating collision warning.

- Such a vehicle is able to obtain its own geographical location, and determine its relative position on the road (e.g., the road lane it is in). One possibility is that, the vehicle is equipped with a Global Position System (GPS) or Differential Global Position System (DGPS) receiver to obtain its geographical position, and it may be equipped with a digital map to determine which lane it is in.
- Such a vehicle is equipped with at least one wireless transceiver, and the vehicular ad hoc networks are composed of vehicles equipped with wireless transceivers.

- ❖ As suggested by DSRC, the transmission range of safety related vehicle-to-vehicle messages is assumed to be 300 meters, and channel contention is resolved using IEEE 802.11 DCF based multi-access control.

Congestion control of EWMs.

It is common that more than one AV coexists in time. For example, if a car stops in the highway due to a mechanical failure, it remains sending EWMs messages to approaching vehicles and will remain AV until it is retired from the road. Also, due to the natural chain effect that is produced in emergency events. The coexisting AVs might send messages at the same time, leading to packet collisions. The VCWC protocol has to deal with multiple AVs.

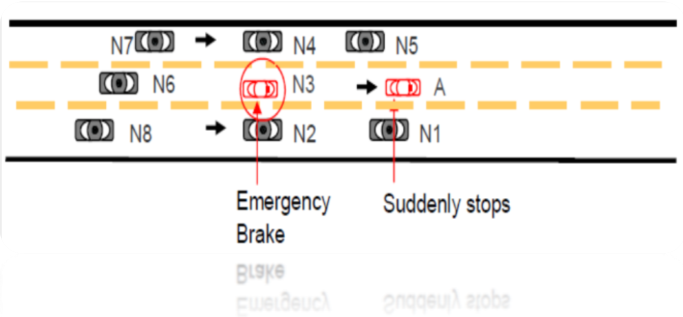

Fig. 4. Typical collision scenario [2]

Another phenomenon might increase the congestion in the network. This is known as Redundant EWMs. Fig.4. shows an example for Vehicle a suddenly stop; N3 breaks because of A detention. In this case, the EWM sent by N3 and the EWM sent by an actually warning about the same event.

To ensure a reliable communication over unreliable wireless channel, EWMs must be repeatedly sent at a certain rate. However, if the retransmission rate is too high, there are more EWM messages travelling in the same time which leads into a high congestion of the network

C. Direction aware broadcast forwarding

For the CCA application, when a vehicle meets an emergency situation, it needs to send a W-CWM to all cars behind within its platoon. Since the identities of those prospective receivers may not be known a priori, classical unicast and multicast routing will not work. In the present approach, the vehicle in an emergency situation broadcasts a W-CWM first, and then all its recipients selectively forward the message based on its direction-of-arrival. This mechanism ensures that the W-CWM will be eventually delivered to all the vehicles within the platoon.

The following design targets have been identified for this CCA system:

- ❖ Minimize the number of vehicles involved in intra platoon chain collisions
- ❖ Prioritize data from safety-related ITS applications over low-priority ITS applications
- ❖ Limit vehicle collisions in the presence of radio channel errors

Upon detecting an emergency event, a WCWM is broadcast by the detecting vehicle. The message contains an *origin_vehicle_id*(of the event detecting vehicle) and an *event_id* (unique within the detecting vehicle), which are used for uniquely identifying the emergency event. An *msg_seq_no*is also added so that the tuple {*origin_ vehicle_id*, *msg_seq_no*} can uniquely identify a message across the platoon. A *message_type*field identifies the associated ITS application, which is CCA in this particular case.

Naïve Broadcast— Naïve broadcast (NB) forwarding serves as a baseline packet-routing mechanism for the target CCA application. After detecting an emergency event, the detecting vehicle starts sending W-CWM messages periodically at regular intervals [4]. According to the NB logic, a vehicle ignores a message if it comes from behind with respect to its direction of movement. However, if it comes from the front, it infers that there is an emergency event in the front and, in that case, the vehicle immediately starts deceleration and starts broadcasting periodic W-CWM messages of its own. Executing the NB logic will ensure that all vehicles within the platoon will eventually receive a warning message and will decelerate to avoid collisions with vehicles ahead. Note that no explicit mechanism has been provided to stop W-CWM propagation. The warning message propagation for an event will stop only when the message arrives at the last car of the platoon, where there is no more receiver vehicle behind it.

Intelligent Broadcast with Implicit Acknowledgment— the primary limitation of NB is its excessive message forwarding, which escalates message collisions for 802.11 MAC. High MAC collisions reduce the message-delivery rate, and also increase the delivery latency, because successful delivery after message drops will have to rely on the periodic retransmissions from the event-detecting vehicle. To avoid these, we introduce an *implicit acknowledgment*-based message generation and transmission strategy, intelligent broadcast with implicit acknowledgment (I-BIA), that can improve the system performance by reducing the number of messages that are injected within a platoon for a given vehicle emergency event.

D. Joint V2V/V2RCommunication Protocol

In Joint V2V/V2R (R2V) communication protocol, when a vehicle (for example V1) has a mechanical failure or detects road hazards, it generates an emergency warning message which includes all the related information and keeps one copy in its buffer for possible retransmission. It then broadcasts it to neigh boring vehicles as well as sends it to a roadside unit, through two transceivers operating in two different frequency bands (in the case of high way scenarios). In V2R (R2V) communication, the source vehicle will periodically send the warning message to a roadside unit until it receives the message with the same event ID from roadside unit. Similarly, the source vehicle will periodically broadcast the warning message in V2V communication mode to neigh boring vehicles until it receive the message with the same event ID from vehicles behind. Once the roadside unit receives the warning message from the source vehicle, it replaces the transmitter ID with its own ID and immediately forwards it to all vehicles within its range.

Working of warning message in V2V and V2R communication modes:

(i) The warning message has been received by the transceiver working in V2R (R2V) Communication mode.

- ❖ If the receiving vehicle is the source vehicle (checking the source vehicle ID in the warning message), it stops retransmitting the warning message to the roadside unit in order to reduce overhead in networks.
- ❖ If the receiving vehicle is not the source vehicle and is in front of the source vehicle, it ignores the warning message.
- ❖ If the receiving vehicle is behind the source vehicle, but has received warning messages with the same event ID from other vehicles in V2V communication, it ignores the warning message.
- ❖ If the receiving vehicle is behind the source vehicle and warning messages with the same event ID have not yet been received, it carries out appropriate maneuvers to avoid collision.

(ii) The warning message is received by the transceiver working in V2V communication mode.

- ❖ If the receiving vehicle is in front of the broadcasting vehicle, it will not rebroadcast the warning message with the same event ID. Again, this is to reduce broadcast messages in networks.
- ❖ If the receiving vehicle is behind the broadcasting vehicle and this message was received before, it will ignore it.
- ❖ If the receiving vehicle is behind the broadcasting vehicle and receives this warning message for the first time, it will carry out appropriate maneuvers to avoid collision.

- At the same time it checks whether a warning message with the same event ID has also been received from its roadside unit. If not, it will periodically transmit this warning message to the roadside unit until it receives a warning message with the same event ID from the roadside unit.

V. Comparative Study

Many Vehicle-to-Vehicle Communication protocols are available for transmitting Emergency warning messages during collision. Here we have compared three different protocols.

TABLE 1
Comparative Study

FEATURES	PROTOCOLS		
Protocols	Vehicular Collision Warning communication protocol.	Direction-aware broadcast forwarding routing protocol.	Joint vehicle-vehicle/vehicle-roadside communication protocol.
Goal	To achieve low latency in delivering emergency warning messages and achieve efficient bandwidth usage in stressful road scenarios.	The objective of this article is to demonstrate how DSRC-based wireless communication protocols can be leveraged for the development of a Cooperative collision avoidance (CCA) application for enhancing highway traffic safety.	To improve the message delivery ratio and obtaining low latency.
Routing Methods	One-way(i.e.)vehicle-to-vehicle.	One-way(i.e.)vehicle-to-vehicle.	Multipath routing(i.e.)vehicle-to-vehicle and vehicle-to-roadside.
Algorithms/Techniques	Rate Decreasing algorithm		Multi-channel technique
Reasons for loss of Emergency warning messages	Packet collision caused by MAC layer	Channel fading, packet errors caused by independent bit errors	No loss of Emergency warning messages
Routing Type	Broadcast	Broadcast	Broadcast
Retransmission time set between intermediate vehicles to transmit EWMs	-	Until sender gets acknowledgement from receiver.	Default set as 6
Reason for retransmission	Packet error and No acknowledgement are received.	Poor channel condition, packet collision, queuing delay	Periodically rebroadcast warning messages to vehicles or roadside unit until it receives the message with the same event ID from vehicle or roadside unit
Concept of Acknowledgement	No acknowledgement is received.	Acknowledgement is received using Intelligent broadcast with implicit Acknowledgement	Acknowledgement is received using Intelligent broadcast with implicit Acknowledgement
Reason for Network overhead	Periodic transmission of messages	Periodic transmission of messages	Network overhead can be avoided mostly because messages are sent through V2V and V2R communication
Retransmission of warning messages to roadside unit is set as	No roadside unit	No roadside unit	0.01 seconds
Advantages	Achieve low latency of EWMs using congestion control policies	One can avoid periodic retransmission of messages by receiving acknowledgement	Communication can be made through both V2V and V2R, acknowledgement is received and multichannel techniques are used to eliminate co channel interference between V2V and V2R by assigning different bandwidth.
Disadvantages	No Acknowledgement is received so we have retransmit the messages and this will increase the network overhead	Multihop unfairness(i.e.)while broadcasting the messages the messages will be lost due to channel fading, effects of mobility and no multipath selection	-
Focus of the paper	Congestion control policies are used to achieve low latency	To avoid cooperative collision between vehicles within the platoon	To achieve communication reliability and achieve low latency.
Reason for unreliable wireless channel between vehicles	Shadowing, Multipath Fading	Channel fading, Multipath Fading	We can overcome unreliability of wireless channel by Multi-route diversity
Reason for packet collision	Continuous transmission of messages and large amount of overhead within network	Continuous transmission of messages and large amount of overhead within network	Packet collision can be avoided by sending messages separately to V2V and V2R.
Wireless services	Unreliable	Unreliable	Reliable

VI. CONCLUSION

From the above review**,** Vehicular Collision Warning Communication (VCWC) protocol improves the road safety and defines congestion control policies for emergency warning messages so that a low emergency warning message delivery delay can be achieved and a large number of co-existing abnormal vehicles can be supported. Vehicle-to-Vehicle wireless communication protocols for enhancing highway traffic safety demonstrate the need of network prioritization and performance sensitivity of CCA to unreliable wireless channel. It can also avoid periodic retransmission of messages by receiving acknowledgement. A Joint V2V/V2R (R2V) communication protocol for cooperatively collision avoiding, in order to improve the communication reliability and achieve low latency by exploiting the transmit diversity has also been analyzed.

References

1. Bin Hu and Hamid Gharavi, “A Joint Vehicle-Vehicle/Vehicle-Roadside Communication for Highway Traffic Safety”, Hindawi Publishing Corporation, International Journal of Vehicular Technology,Volume-2011.
2. X. Yang et al., “A Vehicle-to-Vehicle Communication Protocol for Cooperative Collision Warning,” Proc. 1st Annual Int’l. Conf. Mobile and Ubiquitous Syst: Networking and Services, 2004.
3. Biswas, S. and Tatchikou, R. and Dion, F., “Vehicle-to-vehicle wireless communication protocols for enhancing highway traffic safety,” Communications Magazine, IEEE, Vol.44, No.1, pp.74–82, 2006.
4. Q. Xu, R. Sengupta, and D. Jiang, “Design and Analysis of Highway Safety Communication Protocol in 5.9 GHz Dedicated Short-Range Communication Spectrum,” Proc. IEEE VTC, vol. 57, no. 4, 2003, pp. 2451–55.
5. A. O. Tickoo and B. Sikdar, “Queuing Analysis and Delay Mitigation in IEEE 802.11 Random Access MAC-Based Wireless Networks,” Proc. IEEE INFOCOM, 2004.
6. R. Verdone, “Multihop R-Aloha for Intervehicle Communication at Millimeter Waves,” IEEE Trans. Veh. Tech., vol. 46, no. 4, Nov. 1997.
7. M. Lott et al., “Medium Access and Radio Resource Management for Ad Hoc Networks Based on UTRA TDD,” Proc. ACM Mobihoc ‘01, 2001.
8. H. Hartenstein et al., “Position-Aware Ad Hoc Wireless Networks for Intervehicle Communications: The Fleetnet Project,” Proc. ACM Mobihoc ‘01, 2001.
9. Michael, L.B. and Nakagawa, M., ”Non-Platoon Inter-Vehicle Communication Using Multiple Hops,” IEICE Trans. Commun, Vol. 82, pp. 1651–1658, Oct., 1999.
10. D. Lee, R. Attias, A. Puri, R. Sengupta, S. Tripakis, and P.Varaiya. “AWireless Token Ring Protocol For Ad-Hoc Networks”. In IEEE Aerospace Conference Proceedings, March 2002.
11. R. Meier, M.-O.Killijian, R. Cunningham, and V. Cahill.“Towards Proximity Group Communication”.In Advanced Topic Workshop, Middleware for Mobile Computing, Heidelberg, Germany, Nov. 2001.
12. M. Meincke, M. Lott, and K. Jobmann.“Reservation Conflicts in a Novel Air Interface for Ad Hoc Networks based on UTRA TDD”. In IEEE VTC 2003 Fall, 2003.
13. I. Chisalita and N. Shahmehri. “A Peer-to-Peer Approach to Vehicular Communication for the Support of Traffic Safety Applications”. In 5th IEEE Conference on Intelligent Transportation Systems, Singapore, pages 336–341, Sep. 2002.
14. L. Briesemeister and G. Hommel.Role-Based “Multicast inHighly Mobile but Sparsely Connected Ad Hoc Networks”.In First Annual Workshop on Mobile Ad Hoc Networking &Computing (Mobihoc), August 2000.
15. Z. D. Chen, H. Kung, and D. Vlah. “Ad Hoc Relay WirelessNetworks over Moving Vehicles on Highways”. In Proc.ACM Mobihoc’01, 2001.
16. M.T. Sun, W.C. Feng, T.-H. Lai, K. Yamada, and H. Okada. “GPS-Based Message Broadcast for Adaptive Inter-VehicleCommunications”. In IEEE VTC 2000.

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