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A Proposal of Multi-Channel Conversion System for Inter-Vehicle Communication

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1 Abstract

One of the key goals of a vehicular ad-hoc network (VANET) is communicated by nodes with relative high mobility and various disturbed environments represent a number of remarkable challenges dissimilar to Mobile Ad Hoc Wireless Networks (MANETs). The feature of VANET is that VANET requires reliable communication, therefore, the application of Inter-vehicle wireless communication have the capability to provide a real-time message propagation. In recent years, traditional routing protocols such as reactive of AODV(Ad hoc On Demand Distance Vector)[1], and proactive of OLSR(Optimized Link State Routing) [2]are widely used in VANET. In addition, there are several new proposals such as DCR (Data Centric Routing)[3] which have been researched in VANET. In this paper, a Multi-Channel Conversion System (MCCS) consists of AODV, OLSR and DCR will be present. The capability of this system can identify traffic volume and adjust parameter for appropriate vehicular communication. Meanwhile, the performance of the system will be evaluated and its practicality will be demonstrated either.

2 Background

In Inter-Vehicle communication environment, mobile vehicle implements Ad-hoc network to transmit the information for each other directly. The analyzes of tradition routing protocols for MANETs demonstrated that three protocols have poor performance in VANET[4]. Moreover, there are various constraints such as trees building and other obstacles when VANET was deployed. These constraints have the serious interference of the practical transmission effect as compared to genetic open fields. As an essential part of ITS research, the potential achievement system that enables stable and convenient data transmission to benefit the safety and comfort when vehicle on road.

3 Proposal system

In this section we first compare the three kinds of protocols that have to be taken into account when designing MCCS system. Then, we describe the system architecture and operation for information dissemination.

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3.1 Three types of protocols

3.1.1 AODV

As Fig.1, the AODV protocol performs better in the networks with static traffic, high speed network. Compared with OLSR, the ADOV protocol uses fewer resources. Firstly, the control messages size of AODV protocol is comparative small and requires less bandwidth for maintaining. In addition, the size of routes and the route table can reduce computational power. Therefore, the AODV protocol can be used in critical environments.

	AODV	OLSR	DCR
Type of protocol	Reactive	Proactive	Flooding
ID Information	Need	Need	No
Neighbor Sensing	No	Yes	No
Time of build route	Long	Short	None
End to End Delay (dynamic)	General	High	None
End to End Delay (stationary)	High	Low	None

Fig.1 Compare with three protocols

3.1.2 OLSR

OLSR protocol has more efficient performance in high density networks. The quality metrics can expand to the current protocol easily. For most of the metrics, it was considered that OLSR has the better performance than AODV in VANET. Indeed, OLSR is well suit for application which dese not allow the long delays in the transmition of the data packets. Through these features of OLSR, it was considered that OLSR can be implemented as route building when Inter-Vehicle Communication transmission begin.

3.1.3 DCR

Compared with the tradition end-to-end routing network, Data-Centric technologies have low-rate redundant data and many-to-one flows. DCR is proposed in order to solve the problem of delay by using flooding technology which estimates re-flooding by the data type. Based on this new protocol, ID information of the Vehicular is unnecessary, and dynamic relay control by the data type is possible[3]. For example, DCR can solve the problem of transmission delay effectively when the car emergent brake. Therefore, it was considered that DCR can be used as emergent traffic conditions.

3.2 System Architecture

After the comparison of various existing communication protocols, the purpose of this chapter is to describe the architectural of the Multi-Channel Convert System. As can be seen from Fig.2, the architecture consists of three parts: input device, control unit and wireless device. These devices are implemented at vehicle computer, which interact and show real-time information with each other. The arrows in Fig.2 show the interactions between the various parts of the MCCS architecture.

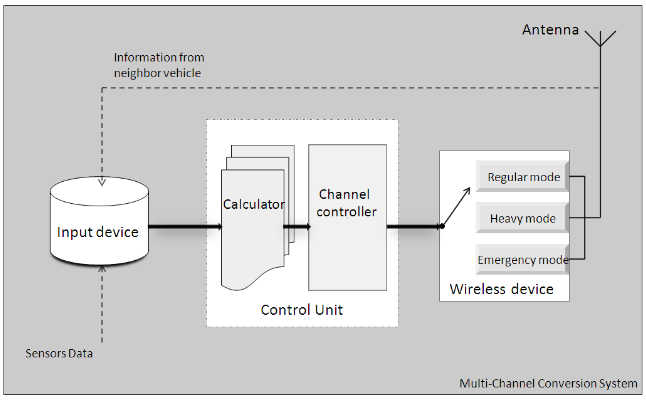

Fig.2 System Architecture of MCCS

1. **Input device** Input device is responsible for receiving information from all types of sensor, and sending parameters to the control unit. For example, vehicle will use the emergent brake action when obstacle was occur in front, brake sensing information will be receiving by Input device. Finally, input unit will send these parameters to calculator.

2. **Control Unit** The main functions of the control unit is to receive parameter from Input unit, and by calculating those parameters, finally, the command call the channel controller for selecting one mode among three modes of system.

3. **Wireless device** The wireless device consists of three modes for communication, the first mode is named Regular mode by using OLSR. Secondly, Heavy mode consists of AODV protocol, and Emergency mode implement DCR protocol as theory basis. The Wireless device switched by channel controller, which can provide the most suitable protocol for in-vehicular communication. At the same time, Wireless device is also receives the information from other vehicles and sent them back to Input device.

3.3 Operating mode

3.3.1 Regular mode (Default mode)

Because of the advantages of the OLSR protocol is that the status of link can be known immediately. Therefore, Regular mode was set for default mode by vehicle computer when it operates. By sending beacon, Surrounding Vehicles can be found. This mode is well suited for environment which prevents delay in the process of data transmission.

3.3.2 Heavy mode

Heavy mode can keep stability of communication in critical environments. Because Heavy mode implement of AODV protocol, it's significant advantage in overhead over simple protocol which need to keep the entire route from the source host to the destination host in their message.

3.3.3 Emergency mode

When the emergency is occur, such as sudden break, vehicle switch from ad hoc mode to the flooding mode (and switch back to default mode at set times). This flooding mode can solve the problems of data transmission delay maximally by using the method of flooding and re-flooding.

4 Conclusions

In this paper related to present the Multi-Channel Convert System (MCCS), a hybrid module architecture that have the capability not only to decrease the rate of packet loss, but also can reduce the delay time in complex and volatile environment. Therefore, it can foresee that as a feasible system, the MCCS can be implemented in the real world. The Future work will focus on further refining and revision of this MCCS with simulator and the feasibility of expansibility of the current system.

References

[1] C.Perkins,E. Belding-Royer and S.Das ”Ad hoc On-Demand Distance Vector(AODV) Routing.”RFC 3561.IETE Network Working Group,July 2003.

[2] T.Clausen and P.Jacquet ”Optimized Link State Routing Protocol (OLSR).”RFC 3626,IETF Network Working Group,October 2003.

[3] Takashi Kato, Hideki Shimada, Takahiron Koita, and Kenya Sato.”Data Centric Routing for a Vehicular Ad-hoc Network” DICOMO2009.

[4] S.Corson and J. Macker ”Mobile Ad hoc Networking(MANET): Routing Protocol Performance Issues and Evaluation considerations.”RFC 2501,IETF Network Working Group,January 1999.