An Implementation of a V2V Communication Safety Evaluation Tool by Using WAVE Device.

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I. INTRODUCTION

Research for Vehicle-to-Vehicle communication has been progressing actively in order to prevent accidents. In the case of United States, the US Department of Traffic and famous car makers have been proceeding in a VSC-A project assembled as a consortium [1]. In the case of Europe, the 7 Working Group has been formed by the Directorate-General for the Information Society and Media (DG INFSO), joined with RITA of United States, and each has been working on their projects according to their own purpose. In the case of Japan, a project called "SmartWay" is being processed by Ministry of Land, Infrastructure, and Transport (MLIT) and the Intelligent Transport Systems (ITS) Spot Service has been applied to a certain section of highways in Tokyo since 2011 as a result. [2]

An application to evaluate whether data is transferred properly via V2V communication is required to prevent accidents. We implemented and verified a tool to evaluate whether the application transfer and receive data properly in V2V communication by utilising WAVE device.

II. METHODS

V2V Communication System

The V2V communication system consist of a test car, WAVE device, GPS device and communication applications, and at least 2 sets are required to conduct the test. The application received GPS information and status of the vehicle and sent it to the WAVE device. The WAVE device performed WAVE communication with other devices by using data which was packed in the Wave Short Message(WSM) format. Fig. 1 shows the configuration and connecting structure of the V2V communication system.

Message Set

The message set transferred via V2V communication was generated in accordance with the SAE J2735 standard.[3] The Basic Safety Message (BSM) was used in a variety of applications to exchange data regarding the vehicle status being safe and sound, and it transferred the required vehicle information periodically to surrounding vehicles by using the broadcast method. Part I of the BSM data must be included in every BSM and Part II of the BSM were included selectively when requested. The Common Safety Request (CSR) message provided a method to uni-cast additional information to the vehicle participating in exchange of a BSM as and when needed.

Test Scenario

We conducted a test that consisted of Vehicle A that generated the event and Vehicle B, the object of observation. If there was a possibility that an event would be generated according to the BSM Part I sent from Vehicle A, Vehicle B would send a CSR for additional information. Vehicle B then analysed the BSM Part II which provided additional information sent by Vehicle A to determine whether the event had occurred or not. If indeed an event had occurred in Vehicle A, a warning message popped up in Vehicle B. Fig. 1 show the flow of messages during the test.

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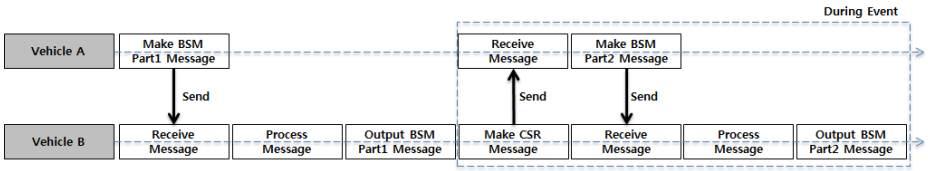

Fig. 1 Flow of messages

For the test, we selected events as following considering local road condition and behaviors of average drivers on it. As a result, it was confirmed that the data was being correctly transmitted and received. also events occurred exactly.

- Emergency Electronic Brake Lights (EEBL)
- Pre-Crash Warning (PCW)
- Cooperative Forward Collision Warning (CFCW)
- Lane-Change Warning (LCW)
- Blind Spot Warning (BSD)
- Intersection Movement Assist (IMA)

V2V Test Tool

The application was developed in the C++ builder XE4 in Windows 7 (32bit) which is capable of monitoring a total of six events to establish if they transfer data properly. The test system which consists of a V2V Test Tool and GPS receiver was assembled and a V2V communication test was conducted for six scenarios. As a result, BSM and CSR messages were properly transmitted and all the events were confirmed to be accurately triggered according to the six scenarios. Fig. 2 shows the output of data in the display of the application for when IMA event occurred.

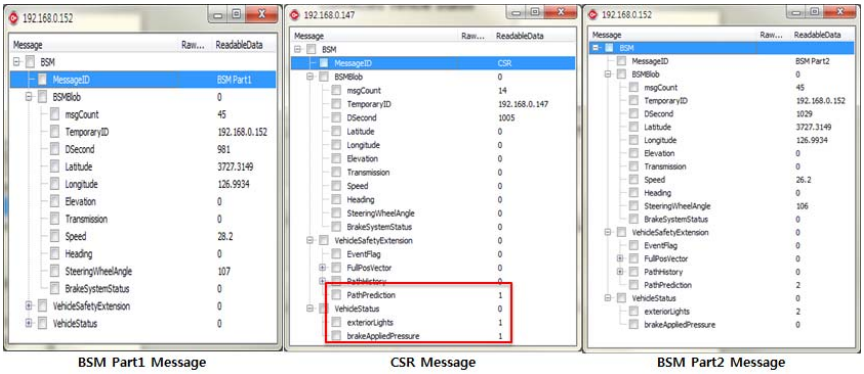

Figure 2 IMA events

III. CONCLUSION

We have implemented an application to evaluate whether the data is properly and safely transferred via v2v communication using WAVE device. Also in order to verify the integrity of the application, we selected the six events and defined data that is supposed to be transferred between vehicles for each event.

IV. ACKNOWLEDGEMENT

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V. REFERENCES

[1] VSC-A, "Vehicle Safety Communications – Applications“, - VSC-A Final Report: Appendix Volume 1 System Design and ObjectiveTest", NHTSA, 2011.
[2] Lina Konstantinopoulou, "D3.14a – International Cooperation activities", FP7-ICT-2011-8_317547, 2014
[3] SAE International, SAE J2735 , 2009