Development of eCall Test Solution using GSM Network Emulation

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[Summary] The eCall (emergency Call) will be implemented for automobiles in Europe from October 2015. We have developed a solution to test the IVS (In-Vehicle System) eCall communication sequence. It supports the communication sequence test between the IVS and PSAP (Public Safety Answering Point) using the MD8475A Signalling Tester and MX703330A eCall Tester software even when testing outside a GSM network area.

1 Introduction

Europe will deploy the emergency Call (eCall) system supporting fast assistance in the event of an automobile accident from October 2015. As a result, all new vehicles sold after October 2015 will be obliged to have an In-Vehicle System (IVS) supporting eCall.

The eCall emergency information system uses the Global System for Mobile communications (GSM) mobile communications technology and the eCall sequence is executed in the following three steps as defined by the European Norm (EN) standard EN 16062.

(1) Step 1: Issue Emergency Call

When the vehicle airbags are deployed in an automobile accident or the emergency call button is pressed, the IVS makes an emergency call to the emergency call center known as the Public Safety Answering Point (PSAP).

(2) Step 2: Transfer Minimum Set of Data (MSD)

When the IVS and PSAP start the communications, the IVS sends accident information called the MSD to the PSAP. The MSD contains the minimum amount of data required to render assistance, such as the vehicle type, number of passengers, location, etc.

(3) Step 3: Confirm Status via Operator

When the MSD is sent, an operator at the PSAP can speak with the vehicle passengers to assess the emergency and dispatch emergency response vehicles.

Since eCall is obligatory, makers of automobiles to be sold in Europe as well as makers of IVS parts urgently need an eCall test environment using the GSM communications technology.

We have developed this eCall test solution to meet this need using the MD8475A and MX703330A measurement software shown in figure 1.

With this solution, in addition to using the MD8475A Signalling Tester to simulate a GSM cellular network, the MX703330A eCall Tester software runs on a personal computer (PC) to simulate the PSAP, thereby configuring an a near-to-real environment for testing the IVS eCall system.

This article describes issues in eCall testing along with solutions and also explains the technical requirements and their impacts on implementing this solution.

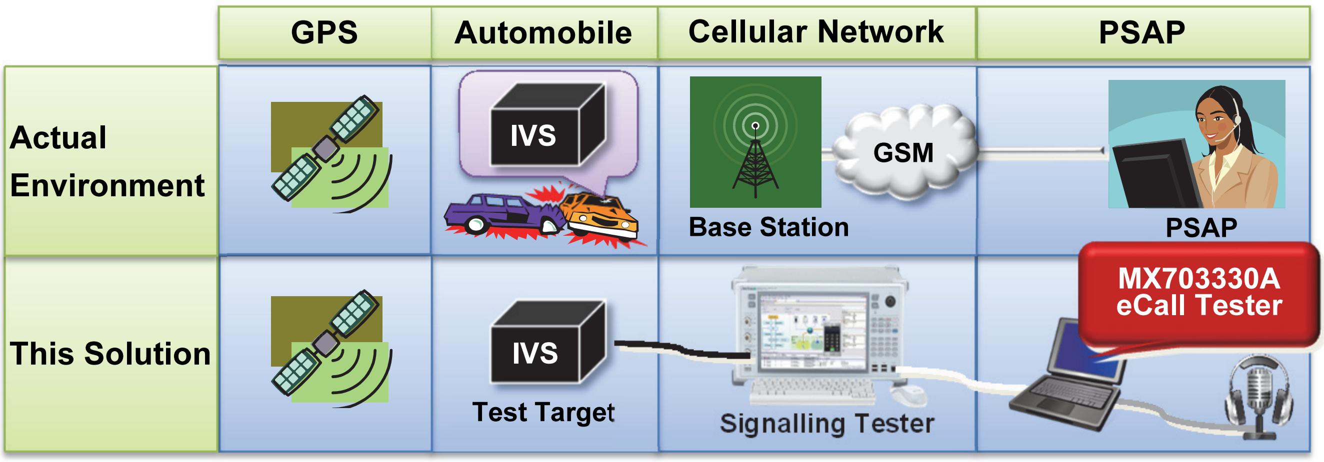

Figure 1 Solution Configuration

2 Conventional eCall Test Environment and Issues

Previously, the IVS eCall system has been tested using a live GSM network but this type of test environment has the following two issues.

(1) Limited Test Locations

eCall uses the GSM cellular network as the communications technology between the IVS and PSAP. As a result, automobile and parts makers performing development in places without a GSM network must move to a location with a GSM network to perform testing, which not only increases transport costs and time but also causes risk of leaks of development data outside the company.

(2) Limited Test Conditions

eCall is an automated system for providing assistance in an auto-accident. Consequently, the system requires speed and high reliability under emergency conditions and the IVS must be consistent as well as adaptable to unusual conditions and compatible with standards.

To achieve this, tests must be run under a variety of communications conditions and circumstances but testing with a live GSM networks makes it impossible to recreate unusual arbitrary phenomena. Additionally, wireless networks such as GSM suffer from continually changing communications conditions due to external factors, such as weather conditions, etc., causing technical problems such as the inability to test under consistent stable conditions.

Moreover, IVS that have not passed approval tests standardized by national organizations and communications carriers can have legal issues preventing connection to live GSM networks.

3 Resolving Issues

We proposed the following methods for resolving issues with the conventional eCall test environment.

(1) Use a simulated GSM network to implement a solution without test-location limitations

Testing can be performed at locations where there is no GSM network by using a signalling tester to configure a communications environment simulating a GSM network.

A signalling tester simulates a mobile terminal base station by reproducing the various communications occurring between the mobile and base station.

Currently, there are a number of signalling testers on the market and we used the MD8475A shown in figure 2 as a base station simulator.

Figure 2 MD8475A Signalling Tester

We chose the MD8475A because it offers the advantage of easy configuration of a simulated GSM network without requiring high-level specialist knowledge related to the GSM wireless standard.

Other signalling testers require provision of base station communications sequences meeting wireless standards. In contrast, the MD8475A executes the base station sequences in response to requests from communications terminals such as a mobile phone, IVS, etc., and uses the built-in SmartStudio software to display these conditions. By using SmartStudio, the operator can quickly configure a simulated GSM network without requiring high-level knowledge about GSM wireless communications standards.

Configuring a simulated GSM network supports IVS eCall testing even before receiving the standards conformance certification required to connect to a live GSM network.

(2) Implement a solution supporting setting of various test conditions

By configuring a simulated GSM network using the MD8475A it is possible to create various communications conditions that cannot be generated on a live GSM network as well as to implement a consistent and stable wireless environment supporting the communications between the IVS and PSAP needed for testing.

IVS to PSAP data communications are implemented using the In-band modem method standardized by the 3rd Generation Partnership Project

(3GPP) TS26.267. This method has a combination of various communications sequences, depending on the data communications status.

Consequently, to execute tests related to the above-described communications sequences, as part of this solution, we developed the new MX703330A software to reproduce the various In-band modem data communications states emulating the IVS to PSAP communications sequence.

By combining the MD8475A and MX703330A functions, this solution supports eCall communications sequence tests under various wireless communications environment and data communications conditions.

4 Implementing Efficient eCall Communications Sequence Tests using MD8475A

In section 3, we proposed combining the functions of the MD8475A and MX703330A as a method for resolving the previous technical issues. This section describes the development of the MX703330A to achieve this proposal and enable engineers developing and evaluating IVS to implement efficient eCall communications sequence tests. The following gives a simple description of the Simplifying Test procedure; Confirming Test Reproducibility; Settings for Developing and Evaluating IVS; and Visualizing Communications State features implemented in the MX703330A.

4.1 Simplifying Test Procedure

Although the MD8475A can be used to implement an eCall test environment without test location limitations, the test procedure becomes complex due to the increase in the number of instruments needed to configure the solution. For example, in a test environment in which the MD8475A and MX703330A are operating independently, the following procedure must be performed when responding to the emergency information by the PSAP.

(1) Confirm emergency information sent from IVS using MD8475A SmartStudio function.

(2) Operate MX703330A to prepare for In-band modem data communications and screen updates to start eCall communications sequence.

(3) Perform operations for responding to emergency information issued by SmartStudio and transfer audio data for MX703330A from SmartStudio.

Consequently, the MX703330A simplifies the test procedure by automating the SmartStudio operations using the SmartStudio external control function required when testing the eCall communications sequence. Table 1 lists the automated SmartStudio control items implemented by the MX703330A.

Table 1 SmartStudio Operation Automation List

Procedure	Measuring Instrument Control
Start test environment	Boots test environment
	Calls test environment
	Starts executing test environment
Change test conditions	Changes output power
	Changes In-network/Out-of-network status
Obtain test status	Obtains communications status
Run test	Executes incoming call answer
	Executes outgoing call
	Terminates call
Stop test environment	Stops execution of test environment

These controls simplify the eCall communications sequence test procedure and the response by the PSAP side to the emergency information is achieved just by the following MX703330A operation.

(1) The MX703330A confirms the emergency information sent from the IVS and manages the response.

4.2 Confirming Test Reproducibility

Automating the GSM wireless communications environment configuration and SmartStudio control eliminates timing differences occurring when a tester performs the operations manually. This creates better test reproducibility, which is an important factor in evaluation tests.

4.3 Settings for Developing and Evaluating IVS

In addition to functions for emulating a wireless communications environment and communications data, we also added functions for setting conditions required for IVS development.

4.3.1 PSAP Timer ON/OFF Setting

A timer is implemented to manage the communications sequence between the IVS and PSAP during eCall communications to execute the three eCall steps (Send emergency information, transfer MSD, use operator to confirm accident conditions) even under bad communications conditions, such as when the radio-wave conditions are poor.

However, sometimes this communications timer function must be disabled when troubleshooting bugs by running tests on the internal status of the IVS and confirming functions step-by-step.

As a result, the MX703330A can be set to disable PSAP timer execution as shown in figure 3.

Consequently, testers and developers can run IVS tests and troubleshoot bugs without being affected by the PSAP communications timer.

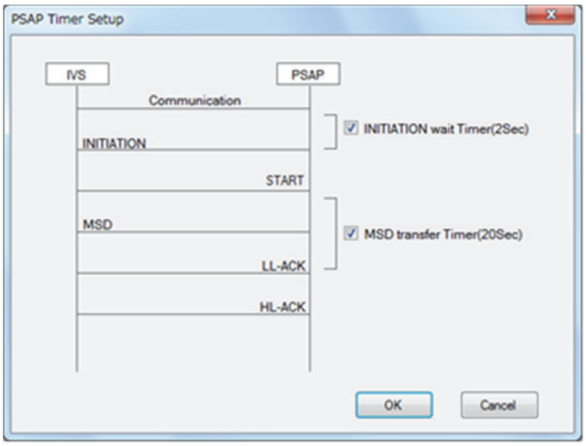

Figure 3 PSAP Timer Setup Dialog

4.3.2 Function for Continuous test

The role of testing is expected to increase to improve the quality of IVS during development. Consequently, we added the following functions to support continuous testing.

(1) Added a function to automate the PSAP response to the emergency information. This starts the eCall communications sequence test automatically without the tester performing MX703330A operations.

(2) Added a function to automatically split and record test results in eCall communications sequence units. This reduces the work of the tester when running the eCall communications sequence and recording the sequence results.

Using these two added functions supports continuous testing of eCall communications sequences and improves the testing efficiency.

Moreover, automated IVS control eliminates the test operator from the IVS and PSAP procedures, supporting an unmanned test environment with repeated continuous testing.

4.4 Visualizing Communications State

When an accident occurs, the MSD is transferred from the IVS to the PSAP as audio data using the In-band modem method. Figure 4 shows an example of the audio data at MSD transfer. It is difficult for the test operator to analyze the status of the communications sequence between the IVS and PSAP from this waveform pattern.

Figure 4 Sample Data of MSD Transfer Sequence

As a result, the MX703330A software aims to improve visualization of the following two items by adding Sequence State View and MSD View functions.

(1) Communications Sequence Status

After demodulating the PSAP communications timer and audio data received from the IVS according to the In-band modem method, the data on the sent emergency information, transferred MSD, and status confirmation by operator, which are used for analysis of the eCall communications system status, as well as the MSD transfer sequence status at the In-band communications used by MSD transfer, are visualized as shown in figure 5.

This makes it easy to understand the status of the communications between the PSAP and IVS as well as the communications sequence.

(2) Received MSD Results

The contents of the MSD transferred from the IVS are encoded using the Packed Encoding Rule (PER) method. Consequently, the test operator must decode the received MSD using the PER method to confirm the MSD contents. Figure 6 shows a decoded MSD message.

Moreover, we have implemented a function to easily and automatically verify the contents of the MSD received from the IVS by comparing the expected MSD using test condition and IVS settings with the received MSD. Figure 7 shows an example of the MSD comparison results. The MSD comparison function highlights differences between the selected parameters for comparison and the input data for comparison, making it easy for the test operator to filter out unnecessary comparison parameters such as accident time stamp and focus only on the important parameters such as vehicle type.

5 Summary

The developed solution supports testing of communications sequences between the IVS and PSAP sides of the eCall system without restrictions on the test location. It improves testing efficiency by assuring reproducible test conditions as well as visualization of the communications status.

This solution can be used by key Japanese automobile manufacturers and auto-parts makers to confirm their eCall test environment for IVS development.

We are continuing with development of solutions to solve the problems and needs of automobile and parts makers in a changing market where IVS eCall conformance testing will be required for smooth deployment of eCall services.

Currently, the automobile industry is starting deployment of telemetrics services, such as eCall, using mobile phone networks, and the telemetrics market seems likely to experience massive regional growth by offering value-added public emergency information services, such as eCall in Europe, ERA GLONASS in Russia, as well as vehicle theft-prevention systems in Brazil.

In this type of business background, the test environment is a critical part of improving services that fuse wireless communications technology with automobile technology.

As part of the Anritsu group, our company is leveraging its experience in wireless communications and mobile phone markets to help develop the telemetrics market by offering various test solutions that include the wireless communications environment.

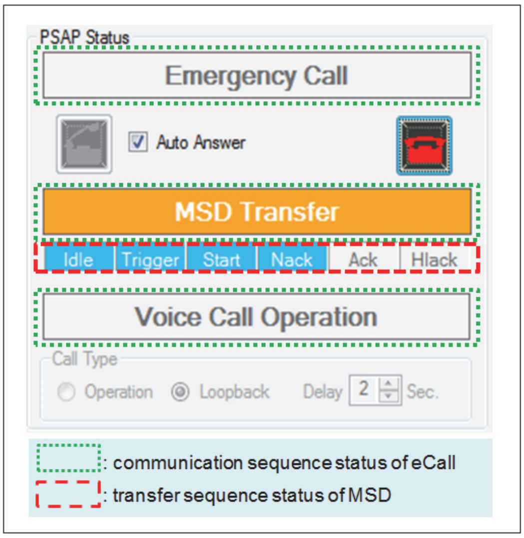

Figure 5 Sequence State View

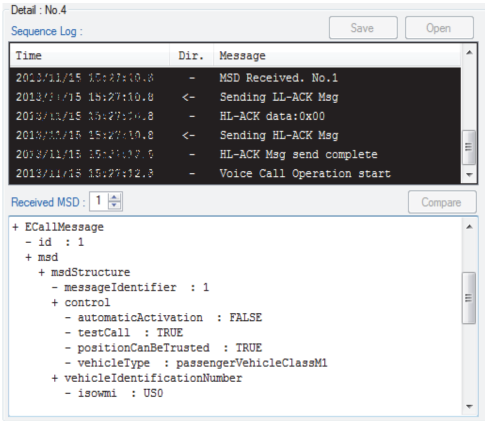

Figure 6 MSD Viewer

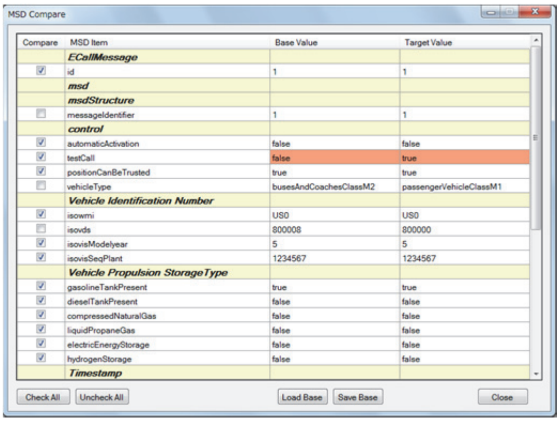

Figure 7 Comparison of Reference MSD and Received MSD

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