Development of Unit for Russian Emergency Call System (ERA-GLONASS)

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Abstract

The vehicle emergency call system is a service designed to reduce the number of casualties in traffic accidents. When an accident occurs, the system is operated and automatically notifies the emergency call center of the specific number and the present location of the vehicle. In addition, a two-way communication with the center is possible in this system.

Ahead of European countries, in Russia, the installation of the emergency call system "ERA-GLONASS" using the satellite positioning system "GLONASS" has become mandatory for all new vehicles that have been released from 2015.

This paper introduces the initiatives of the world's first control unit approved for the emergency call system "ERA-GLONASS". The unit was co-developed by a non-Russian automobile manufacturer and an in-vehicle device manufacturer.

1. Introduction

The vehicle emergency call system (hereinafter "eCall") is an emergency call service that enables either manual or automatic dialing of an emergency call number when an emergency occurs, automatically notifies the emergency call center of the vehicle identification number (VIN) and current vehicle location, and enables two-way communication **(Fig. 1)**.

eCall was established in order to reduce fatalities due to automobile accidents and the system is being introduced in various countries.

Preparations for market deployment of eCall in Europe started from the beginning of the 2000s with due to requirement of mandatory equipment on new vehicles starting from April 2018. Additionally, Russia is leading Europe in these efforts with the "ERA-GLONASS" emergency call system using GLONASS, a Russian satellite positioning system, and equipping vehicles with this system has been mandatory for all new vehicles sold since January 2015. DENSO TEN is currently developing, manufacturing, and selling products (eCall control units) to multiple automobile manufacturers.

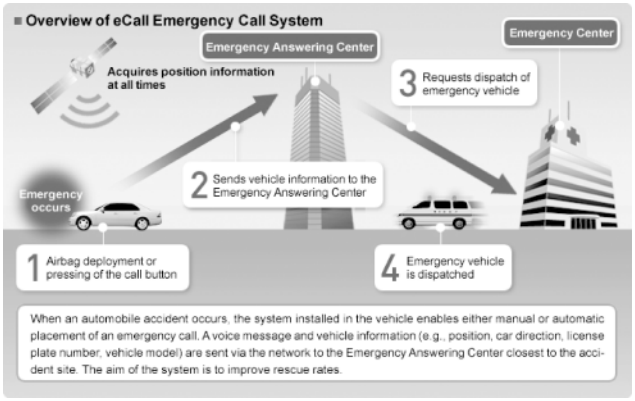

Fig. 1 Overview of Vehicle Emergency Call System

In this paper, we present the history of emergency call and introduce the efforts of DENSO TEN in regard to the eCall control unit.

2. History of Emergency Call in Various Regions/Countries

(1)USA

1996:Emergency call service starts with OnStar, a telematics service from GM

2003:Toyota and Honda also start using OnStar as an emergency call service

Features: Services provided by completely private companies. Methods such as using a voice modem to transmit location can be said to be the original model of ERA-GLONASS and European eCall.

(2)EU

1999:BMW starts an emergency call service as part of its telematics service.

2002:The European Commission starts legal studies and making preparations for implementing eCall.

Goal of mandatory equipping was set for 2010.

2010:Organization/Framework for studying eCall was established.

Mandatory equipping was postponed until 2015.

2014:Final draft of law was issued and mandatory equipping to new vehicles was postponed until April 2018.

Features: Although BMW and other private companies started an emergency call service early on, it took a total of eight years to obtain the consent of each country as a requirement for EU legislation, including time to construct the infrastructure.

(3)Russia

Around 2008:Consideration of eCall introduction in cooperating with EC.

2011:Related laws and regulations were issued and the mandatory equipping for new vehicles was set to start 2013.

2013:Mandatory equipping was postponed until January 2015.

2015:LADA (Russian automobile manufacturer) was the first company to obtain vehicle certification for ERA-GLONASS in September (vehicle released in November).

Features: Contains a function that sends the VIN and vehicle location information to the emergency call center by SMS (short message service) if the voice line connection with the center is lost.

(European eCall does not currently have this function.)

Vehicle certification is inconvenient as it currently can only be obtained from Russian certification organizations, and on-vehicle devices must be continuously improved because the law is revised and the test contents are updated every three years.

(4)Japan

1999:A Japanese emergency call service (HELPNET) was established for the purpose of constructing, operating, and managing the corresponding system (including infrastructure and similar elements) with investment from automobile companies, on-vehicle device manufacturers, communication carriers, and insurance companies.

2000:Start of HELPNET emergency call service by use of on-vehicle devices (Toyota and Nissan).

2005:Standard equipment for all Lexus models

Features:The service is built jointly by the government and private sector in order to provide rapid handover to the police and fire department in case of an emergency. In consideration of the unique complicated Japanese road conditions (such as complicated alleys, overhead crossings, high-speed side-by-side driving), driving paths have been matched to maps by the navigation system and transferred to the center. This is an unprecedented effort in other countries.

3. DENSO TEN's Efforts

Services required for cars are currently becoming more diversified due to the introduction of connected cars. And the one of the key products for this is telematics control unit (TCU) which connects cars to the social infrastructure by use of mobile networks.

From the 1980s, DENSO TEN has developed, manufactured, and sold body system control devices, which provide convenience, safety, and security, focusing on automobile manufacturers. One of these products was a remote engine starter (RES) that remotely started the engine by use of a remote transmitter and adjusted the cabin air conditioning before boarding into the vehicle.

DENSO TEN started producing products connected with mobile networks from around 2012 due to the changes in the market environment such as the rapid acceleration of mobile networks and smartphones. This resulted in equipping vehicles with telematics service functions that can control vehicle door locking, engine starting, and air conditioning via mobile networks and commercialization of RES+.

At the same time, DENSO TEN has carried out various activities in order to investigate trends in each country regarding the mandatory equipping of eCall, one of the main telematics services. These actions, such as early-stage participation in ITS-themed events held in countries all over the world

and verification testing projects, have enabled the company to obtain product specifications and design know-how. We introduce the following representative measures, with ① and ③ concerning verification testing in the actual market, and ② concerning mobile network interconnection using actual equipment on a workbench.

① HeERO Project Phase II (2013 to 2014)

DENSO TEN participated in this project to perform actual driving test of eCall promoted by ERITCO (European public/private cooperative organization for promoting ITS) in collaboration with European countries and companies. By providing our eCall control unit to Luxembourg, Denmark, and Finland, DENSO TEN verified coverage areas of mobile networks, as well as contributed to benchmarking items such as the verification when connected to a center, and accumulated relevant know-how and product improvements by feeding back the results of verification tests to our eCall control unit.

② Test Fest (2013 to 2017)

DENSO TEN participated in this test event held annually by ERTICO in order to promote preparations for eCall. On-vehicle device manufacturers, emergency call centers of various countries (including PSAP manufacturers), and instrument measuring manufacturers participated in connection testing using all the various combinations, resulting in improvement of inter-device compatibility.

DENSO TEN has participated for 5consecutive years in this event, and we have been able to confirm connection with a total of 14 PSAP manufacturers and emergency call centers of various countries.

③ ITS European Congress 2014

DENSO TEN provided the eCall control unit for experiments to verify compatibility of eCall in Europe and Russia at this event held in Finland by ERTICO. This event was successful in proving that a Russian vehicle could make an emergency call even after crossing the border into Finland, and this goes same in European vehicle making an emergency call after crossing the border into Russia.

4. Development of ERA-GLONASS

Fig. 2 shows the structure of ERA-GLONASS that was made into a marketable product by DENSO TEN.

It consists of a microcomputer that controls the system, communication module that communicates with mobile networks and performs positioning measurements, SIM, amplifier that drives the speakers, and a built-in backup battery for the case when the car's battery fall into disconnection or breaking of cable.

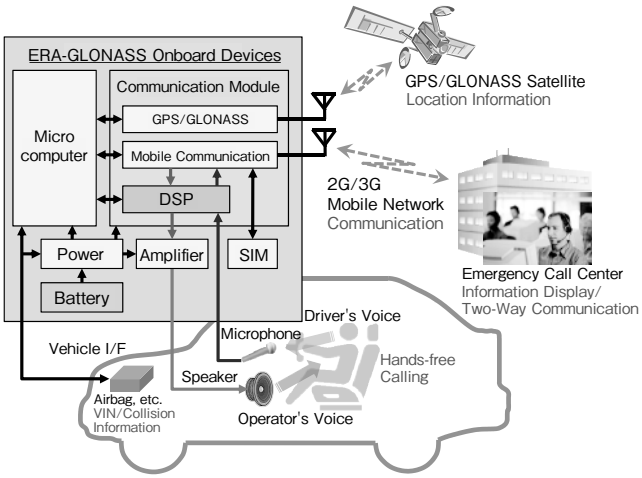

Fig. 2 Structure of ERA-GLONASS

Next, we share some of the difficulties which we faced in the development of ERA-GLONASS.

①Right Interpretation of Laws and Incorporation to Product

As we mentioned before, the introduction timing for eCall was postponed in Europe but Russia set January 2015 as the date of mandatory equipping in 2013 without postponing, and moved to the phase in which legal requirements are incorporated into the product. However, as the contents of the laws and regulations are vogue, there are many interpretations possible. For this reason, DENSO TEN started gathering information by continuing to attend various events held in Russia and Europe, and simultaneously obtain legal information, and built connections with the key persons (such as those related to drafting the laws and regulations, certification organizations, and manufacturers of instrument measuring and other devices). This allowed us to enlist the interpretations of these key persons and to incorporate legal requirements one-by-one into the product.

②Voice Parameter Tuning for Two-Way Communication

Two-way communication is possible in eCall between a user in the vehicle cabin and the emergency

call center by using the microphone and speakers installed inside the vehicle cabin. A digital signal processor (DSP) is used to perform various types of voice processing so that the conversation is as natural as possible during hands-free calling because the microphone can pick up the sound coming from the speakers, which causes howling.

Adjustment of DSP parameters has been used until now in the automobile industry to satisfy the requirements for two-way communication of the German Association of the Automotive Industry (Verband der Automobilindustrie (VDA)). Finally, our products were determined whether they passed or not based on the audibility tests by automobile manufacturers. However, Russia had made it legally required to absolutely satisfy all of the items in the VDA standards for vehicle testing related to two-way communication. Thereby this was regarded as one of the extremely difficult requirement to be achieved.

Specifically, there are some requirements conflicting with two-way communication standard, which makes it extremely difficult to adjust voice parameters inside the TCU. For example, there are echoes and double talk (DT (simultaneous speaking)). If testing related to echoes is implemented with priority and the voice parameters are adjusted, the test margin related to DT is conversely reduced, and vice versa. Moreover, conditions such as cabin space differences of each vehicle model, and the installation position of speakers and microphones also comprehensively have an effect on test results. In order to respond these, DENSO TEN started organizing the effects caused by each voice parameter by analyzing the background and intention of the various evaluation items and measurement conditions as the first approach. At that time, the advice from experienced personnel in DENSO TEN who worked on the design of a taxi radio, and realized hands-free communication over 30 years ago, was greatly useful. Furthermore, reviews with instrument measuring manufacturers and tirelessly pursuing joint evaluation finally resulted in satisfying the requirements, and also we were able to establish the procedures for efficiently tuning voice parameters in order to obtain conformity.

③ Measures to Acquire Authorization Certificate

There was still no certification organization to acquire the authorization certificate when the Russian law was officially enacted at the beginning of 2014. For this reason, the first issue was finding a certification organization that could perform the necessary testing.

At that time (beginning of 2014) the main attitude in regards to assigning and preparing certification organization was to start it while seeing how things go after the law enacted, because it was difficult to determine whether cost recovery corresponding to the investment needed could be achieved. On the other hand, since the law was being enacted at the same time as vehicles were to be shipped to market, DENSO TEN performed wide-ranging studies and widely visited to certification organizations in Russia, Europe, and Japan. Thereby it resulted in an early start to taking certification testing and also resulted in finding certification organizations that could meet the vehicle schedules.

The next issues were to obtain consent for the testing methods for certification testing, and to create the corresponding testing procedures. Test applicant needed to submit a procedure manual that described the testing methods and testing procedures conforming to the law as well as the testing results. While certification organizations were examining testing methods through trial and error, writing of the testing procedure manual involved difficulties in necessary technology and labor-time. Depending on the item, there were some cases not only correcting the procedure manual but also resulting in changing the product specifications because of the testing methods. For these reasons, DENSO TEN was persistent in having face-to-face meetings with certification organizations to hold discussions and negotiations regarding testing methods, and finally managed to acquire certification as planned.

5. Conclusion

ERA-GLONASS system certification was completed on December 28, 2015, and authorization numbers were issued for vehicles on the 29th of the same month. While many automobile manufacturers were forced to postpone the release of new models in Russian because they could not acquire ERA-GLONASS certification, DENSO TEN was the first

in the world to acquire it through a combination of non-Russian automobile manufacturers and on-vehicle device manufacturers.

I still remember it just like yesterday that we enjoyed a celebratory katsudon (fried cutlet rice bowl) with personnel from related automobile manufacturers at a Japanese restaurant in the Moscow Trade Center after Christmas and just before the New Year's Eve.

Afterwards, we have received numerous inquiries regarding eCall and ERA-GLONASS from within Japan and abroad, and we are currently receiving orders from automobile manufacturers for TCUs equipped with these functions.

We would like to continuously work on developing the TCU business to be one of the cores of DENSO TEN's business operations.

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・HELPNET is a registered trademark of Japan Mayday Service Co., Ltd.

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