INTELLIGENT VEHICLE SAFETY SYSTEMS-eCALL

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ABSTRACT

The European Union is promoting *eCall* to reduce the number of roadway fatalities by minimizing the response time when an accident has occurred. *eCall* is a combination of an In Vehicle System (IVS), a device with a GSM cell phone and GPS location capability, and a corresponding infrastructure of Public Safety Answering Points (PSAPs) Intelligent Vehicle Safety Systems use Information and Communications Technologies for providing solutions for improving road safety in particular in the pre-crash phase when the accident can still be avoided or at least its severity significantly reduced.With these systems,which can operate either autonomously on-board the vehicle, or be based on vehicle-tovehicle or vehicle-to-infrastructure communication (co-operative systems), the number of accidents and their severity can be reduced. Location-enhanced emergency calls like in-vehicle e-Call have their primary benefit to society of saving lives and in offering an increased sense of security. The articol presents the system eCall and how does it work.

Keywords: eCall, functional architecture, PSAP

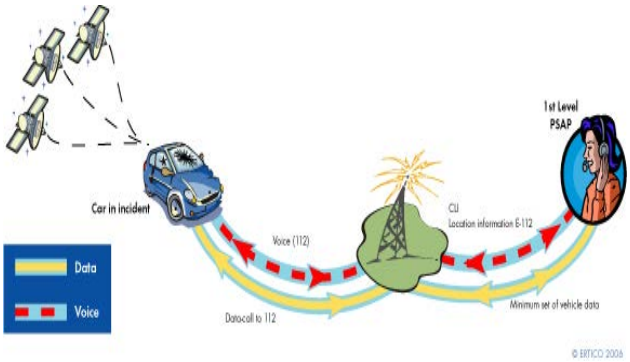
1. INTRODUCTION

The EU plans to have every new car equipped with the eCall system from 2010. The system will automatically generate an emergency call after a serious accident. With this call, the data of the vehicle including location is transmitted to the 112 emergency call centre.(PSAP)

The eCall Generator initiate the eCall by sensors triggered and/or manually, send the in-vehicle triggered eCall to a PSAP. The eCall consists of two elements: a pure voice (audio) telephone call based on 112 and the minimum set of data (MSD)

The eCall (data + voice) carried through the mobile network, is recognized by the mobile network operator (MNO) as a 112 emergency call, and is first handled by the MNO. Based on the 112 handling the MNO enrich the call with the CLI (caller line identification), and at the same time, according to E112 recommendation, add the best location available .After the 112 handling, the telecom operator delivers the 112-voice together with the CLI, mobile location and the eCall MSD to the appropriate PSAP.

The PSAP transmits an acknowledgement to the eCall Generator specifying that the MSD have been properly received.[1]



2. eCALL SERVICE CHAIN

The overall performance criteria for the eCall service chain have been derived from a range of studies and experiences from the various stakeholder groups involved. Furthermore, experiences from comparable automatic and manual vehicle emergency or assistance calling systems and current PSAP operation systems and emergency response systems have been taken into account.

eCall involves a number of different stakeholders all with separate responsibilities and tasks, which even overlap. In order to provide a clear understanding of the different aspects of the eCall chain six different domains have been identified :

- Vehicle eCall Triggering System —›112 eCall Trigger (eCall sensors or manual) —› Transmission over vehicle bus
- eCall Generator (EG) —›In-vehicle software triggers 112 call —› in-vehicle communication module initiates 112 all and send MSD
- EG 2 MNO —› Receive 112 call and MSD
- Mobile Network Operator (MNO) —› 112 call with CLI, celluar location and MSD
- MNO 2 PSAP —› Forward 112 voice, CLI, celluar location and MSD to PSAP
- PSAP —› Answer 112 voice call, decode and visualise celluar location and MSD

3. FUNCTIONAL ARCHITECTURE

The eCall IVS function is to :

- Collect data from the vehicle network and from vehicle sensors, and maintain an up-to-date GPS fix of the vehicle's location.
- Automatically detect a crash based on car-sensor information.
- Call a PSAP automatically when a crash is detected, or when the driver presses a dedicated *eCall* button.

Each call has 2 main parts:

- Establish voice contact between the car's occupant and a PSAP operator to provide assistance to the driver.
- Transmit a Minimum Set of Data (MSD) to the PSAP, including the current GPS position and direction the car was heading.[5]

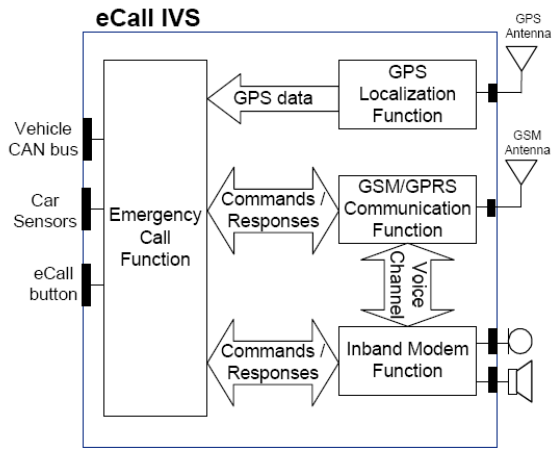


Figure 1: eCall - functional architecture.

Figure 1 depicts the architecture of an *eCall* IVS. Its functional blocks are:

- Emergency Call Function: This is the *eCall* application. It gathers vehicle information through the CAN bus or other sensors and geo-location information from the GPS function. In case of a crash, it sends an emergency message to the PSAP through the GSM/GPRS function.
- GPS: The GPS function is responsible for gathering information from GPS satellites and processing this information to accurately compute the vehicle's geo-location.
- GSM/GPRS: The GSM/GPRS function is responsible for establishing and maintaining a GSM call to the PSAP so that the crash information can be sent and a voice connection established between the car occupants and an operator.
- In-band Modem: Among a few technologies to send data to the PSAP (SMS ,GPRS or inband modem), the most likely to be used is the in-band modem. This technology uses the voice channel; typically a special processing unit in the audio path encodes/decodes messages.

4. eCALL MINIMUM SET OF DATA (MSD)

The requirements to the minimum set of data were set by a group of emergency services involved in the Driving Group (DC) eCall. The requirements were based on the information that emergency agencies would need to speed up the response time and to ensure a correct deployment of emergency resources.[2]

The DG eCall recommends that the below MSD content should be standardized by an appropriate standardization body.

The MSD provides the following information:

- GPS Position
- Direction of travel
- Number of triggers of the call
- Colour, make, model of the vehicle
- Indicates which sensors are triggered: airbag, roll-over, front crash, side crash or rear crash sensor (at least two should be activated)
- Time stamp of the event
- SP ID(Service Provider Identification)
- SP telephone number
- Country ID, and
- Special vehicle /user code.

It is recommended to send the minimum set of data in the 112-voice channel to the PSAP via a specific vehicle protocol - Global Telematic Protocol (GTP). During testing the consortium decided to use short message service (SMS) to transfer the eCall MSD to the PSAP and if subscribed there to the full set of data (FSD) to the Service provider using the same vehicle protocol (GTP).

The PSAP is the public controlled call centre responsible for providing a first point of contact to a 112 call. The PSAP is thus receiving the Emergency 112-voice call and the MSD. Based on the voice connection and the MSD content, the PSAP operator decides the handover to the correct dispatcher, which will handle the remaining part of the specific emergency response. The PSAP's source of information is the voice, the MSD and the location information provided by E112. For cases where the driver is subscribing to a SP the additional set of data can be pulled by the PSAP operator over a secure Internet IP connection. It may happen that the PSAP operator does not speak the language of the driver involved in the accident. In that case and under the sole condition that the driver has a service provider subscription, it is possible for the PSAP operator to set up a conference voice call between himself, the vehicle occupant and the operator at the responsible service provider.[4]

The specification of the minimum set of data was created by the emergency agencies. These specifications were set on the basis of the information the emergency agencies would need to make a correct response and to speed up the response time. The definition of the MSD was made in close co-operation with the vehicle makers because in the end, the vehicle manufactures need to make sure that the information was present. The minimum set of data has been coded using the GTP protocol and consists of the following information that will be forwarded, together with the voice call, to the PSAP operator when receiving an in-vehicle eCall:

- "When" via time stamp
- "Where" via precise locations (e.g. satellite positions including the direction of driving)
- "Who" via vehicle description (caller line identification [CLI], colour, make and model including, if possible the vehicle identification number, VIN)
- "Where to obtain more information" via service provider identifier (IP address, including for example telephone number and country code), and
- "How severe" via eCall qualifier (source of the trigger – manual or automatic including what type of sensors or, if available, the number of sensors).

The minimum set of data makes it possible for the PSAP operator to respond to the eCall even without the voice connection. It was requested by the PSAP operators that at least two sensors should be activated and send information to the PSAP before they deal with the call as a silent call. The reason being that the PSAP wanted to minimise the number of false calls in case of a failure on a sensor in the vehicle. The minimum set of data is critical for supplying the correct service to the crash-site and to speed up the response. It is generally expected by the PSAP's that the response time can be improved by 5-10% when this information is available at the PSAP immediately after the crash.

The necessary standardisation activities in Europe related to the technical solution for the implementation of a pan-European emergency eCall system for road vehicles cover two main issues: (1) the transport protocol by which the minimum set of data (MSD) will be send via the mobile telecommunication network (e.g. GSM) to the public service answering point (PSAP), and (2) the content and format of the MSD.

The Commission approached ETSI in 2005 to look for developing supporting standards for eCall. ETSI subsequently divided the work into two parts [3]

a) the agreement of a communication link (transport protocol) was assigned to ETSI MSG
b) a standard to specify the overall architecture and MSD was assigned to ETSI ERM TG37.

5. CONCLUSIONS

In order to make the reporting of an accident more simple and to give the emergency call operator more information about the accident the European Commission launched a communication telling the EU Member States to implement the single European emergency call number 112, which has been follow by all EU Member States. In addition the European Communication launched a recommendation about the enhanced E112- number, with also provides the location when an emergency call is made from a cellular phone.

The problem with the existing eCall solutions provided by the different vehicle manufacturers and service providers today is that they only operate in on country.

From the network operators and service provider's perspective they are developing different systems for all vehicles manufactures, which is making the system expensive and not able to work across the different EU Member States [3]

Another conclusion is that if there should be a Pan-European eCall system, the vehicle manufactures or the network providers can't develop this themselves. It is very important to include the public authorities in this matter and the public body for this has to be the EU. Only here can a solution be pushed across all EU Member States.

6. REFERENCES

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