Further challenges of eCall service and infrastructure

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Abstract

The approaching deadline for eCall service implementation for new cars in 2018, raises a series of technical and logistic issues. The eCall service, part of iCar initiative, aims to reduce the road fatalities and severity injured person reduction, for post-crash situations. The eCall service consists into an In Vehicle System (IVS), which will be delivered mandatory on new cars, starting with 2018, able to transmit, in case of an car accident, the necessary data for 112 emergency system. The IVS transmit relevant information, as accident coordinates, type, model, colour, owner using a data message, using Public Land Mobile Network (PLMN). The data packet is treated as an emergency call using a flag discriminator under the form of Minimum Set of Data and carried to nearest Public-Safety Answering Point (PSAP) managed by emergency organizations. After MSD is resolved by 112 systems and relevant information is displayed to 112 operators. After 20 seconds, the 112 system initiates a voice call-back to the source of MSD. The IVS now is used as regular cellular, the operator getting contact with the car driver. If the operator cannot establish a connection and identify the severity of the crash, will dispatch a standard emergency team. However, the eCall can be triggered also manual, pressing a button installed in the car, if the driver is suffering a heart attack or is witness of another accident. In this paper are debated further challenges of eCall implementation, given by adapting the service to specific types of vehicles, like two wheels' vehicles, heavy goods vehicles, dangerous goods transportation and long distance vehicle transports. The results presented were obtained into iHeERO project, financed by European Comission and previuos research.

Keywords: Intelligent Transport Systems, emergency systems, eCall, iCar

1 Introduction

In 2004, European Commission started the e-Safety plan, aiming to reduce road crash fatalities. This plan is part of a larger initiative called Intelligent Car Solution i2010. The e-Safety plan was to cover all phases regarding road accidents: *exposure, crash avoidance, injury reduction* and *post-crash* situations.

The concept of Intelligent Transport Systems (ITS) was introduced by e-Safety, considering the implementation of IT&C on-board of vehicles to reduce or avoid the accidents and consequences limitation. As part of iCar promoted systems, eCall offers the possibility of accident advertising to PSAP, using an automatic sequence of data and voice call, from incident car to PSAP and backwards.

In Figure 1 is presented the eCall service chain. When an accident occurs, the on-board eCall system module, called IVS initiates a data transmission under the form of MSD, containing references regarding time of accident, place, car involved or some additional information. The MSD is carried by MNO through PLMN and treated as emergency call, using the emergency flag. The MSD arrives to PSAP and it is presented to PSAP operator. To link the car details, like: color, manufacturer, owner etc. the Vehicle Identification Number (VIN) is used. After the MSD is received, the PSAP initiates a call to the vehicle implied in the accident to gather additional information to size the emergency team that will be dispatched on the crash site.

The IVS contain an GNSS module, who offers the position of the accident, embedded in MSD. The IVS contains also an In Band Modem to connect the IVS to PLMN. A full description of IVS was given in [1], using the standard given specifications.

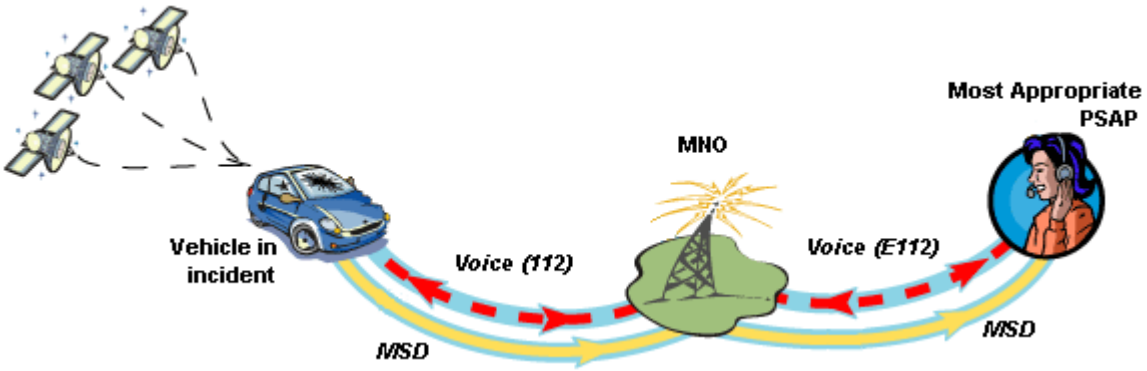

Figure 1: eCall service chain. [2]

It is estimated, accordingly to the European Commission studies, that more than 2 500 lives will be saved each year using the eCall service on full deployment. The implementation of the eCall faced a series of delays, but now it has been scheduled to be operational starting with 2018.

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2 Previous work and eCall barriers

2.1 HeERO projects

After e-Safety plan approval, the Forum assembled around e-Safety initiates in 2004 a Memorandum of Understanding (MoU) for Realisation of Interoperable In-Vehicle eCall. This was one of the first steps towards an integrated and interoperable service among European Union. The design and implementation of such service demanded a strong support from EC and European Parliament, formalized as Directives or approved legislation.

As part of the design and implementation, it faced several barriers, opposing to a large and harmonized adoption of eCall. The efforts were concentrated over PSAP upgrade, from state members, in order to be able to operate eCalls. The first sustainable initiative of EC was to fund HeERO project. It begun in 2011, with a three years' duration, HeERO concerning the pan-European in-vehicle emergency call service "eCall".

The main objective of HeERO was to create the necessary infrastructure and fully demonstrate the eCall operability. A list of secondary objectives was aimed also, by the consortium organized in nine pilot sites, one for each country (Croatia, Czech Republic, Finland, Germany, Greece, Italy, The Netherlands, Romania and Sweden). This list covered interoperability and cross border continuity, harmonization across Europe, by implementing available eCall standards, infrastructure upgrades and recommendation for future implementations.

The second HeERO project - HeERO 2, with two years' duration, started on 2013. New 6 countries (Belgium, Bulgaria, Denmark, Luxembourg, Spain and Turkey) have joined to HeERO infrastructure. Also, from the consortium made part also associate partners, without EC funding but granting HeERO expertise.

The preliminary results of Harmonized eCall European Pilot (HeERO) reported by Romanian pilot site in [3]. The implementation of eCall in reported case supposes to route all eCalls to Bucharest, as central PSAP having eCall functionality with a backup situated in Brasov county. It must to be said that Romania has 41 PSAPs, one for each administrative areas (counties). The preliminary call, carrying the MSD is routed from the MNO to Telecom network and presented to nearest PSAP. Because of flag discriminator the signalizes an ecall, the call is routed to Bucharest PSAP. The emergency scenario supposes that after the MSD is resolved and presented in Bucharest to be transferred to nearest PSAP. The same pilot site is presented in [4], revealing a succession of over on thousand live tests performed by Special Telecommunication Service (STS) in Romania in 2012. The STS operates the emergency call unit service in Romania. The tests were made using two different IVSs, having test, automatic or manual triggering condition. Also, the operational tests covered different kind of landscapes and roads: urban, rural, highways and mountain areas. The goal of the study was to measure the availability of the service and two KPIs: one being the time spent between eCall initiation and MSD presentation to PSAP and second, the duration of voice channel blocking by MSD.

They used two scenarios, with and without eCall discriminator flag. The discriminator flag signalizes to MNO operator that present call is an emergency call. The flag was introduction was necessary because, before eCall, the usual direction of an emergency call was from caller to PSAP and not backwards. The reported results showed an over 92% availability of the service and KPI 1 from 23s in urban area to 33s in mountain and for KPI 2 with 14s in urban area and 18s for the mountain section. The study revealed that the availability of the service is strictly correlated to MNO performance in the tested area, with poor values in mountain area. Also, if the flag discriminator isn't properly configured by MNO the MSD is routed to a wrong PSAP (without eCall function) and presented to the operator as silent call.

2.2 eCall barriers

Starting from the eCall definition, this is an automatic call triggered by in vehicle sensors in case of an accident. In [5], the authors evaluate the perspective of automatic triggering of eCall, based on UK case study. The study is built using data collected in the period 2000 and 2010 of car road accidents in UK. They assumed two automatic triggering conditions. First, when the frontal or lateral airbag is committed. The second automatic triggering situation occurs when any airbag is activated. According to the study, only 20 % of total injuries (including fatalities, serious and slight injuries) might be reported, using first condition. In case of second automatic triggering condition, if uses any airbag as input, the sensitivity will rise up to 65%, with even higher values (85%) in case of fatal and serious injuries. Furthermore, the study presumes that eCall service is working without failure. Anyway, the authors couldn't recommend a single triggering condition. The sensors group that trigger the automatic emergency call service remains on car manufacturer choice.

Even if the main purpose of eCall is to save lives, by reducing the intervention time of rescue teams by a proper localization, other issue that may arise is the cost effectiveness. In [6], are presented some business models for aggregating data obtained as a results of an accident. The first one, is theft prevention in case of false car crush, when the owner reports accidents to insurance companies to recover unrealistic damages. So, the insurance company might compare the real accident data with the reported ones. The second, to point into a GIS application, the spot of accidents and to offer alternative routes for drivers. The third, is to use accident data to study various security measures impact, or filtering by car manufacturer, car model etc. Integrating eCall data to Traffic Management Center (TMC) is a must, for proper using of data in real time, conducting to efficient traffic management measures in real time. Nowadays, because of wide spreading of smartphone application, the drivers use in most cases, for unknown destination, the routing application that can point accidents place in real time using on-line connection. Furthermore, the TMC offers, on institutional site the position of major accidents.

The eCall limitation to data and voice communication, using mandatory an MNO number to register into the network, due to security reasons, might be exceeded by using IoT technology. In [7], the NEXES project is presented, proposing an extended concept of emergency message content, including video calls, multimedia messages from smartphone applications, social media, Voice-over-IP (VoIP) or real-time text (RTT). Although, defining Next Generation of Emergency Services is an undergoing process, some reference architectures being published as position papers by various actors involved in the field (e.g. EENA). Anyway, it should be emphasized the gap between today communication facilities (e.g. voice call, MMS, enhanced content from apps etc.) and the ones that emergency services approved to work with. There are only recognized as such the voice calls. So, even it was started almost ten years ago, the eCall it isn't ready yet, having a wide range of issues. Otherwise, it cannot be expected that such complex systems needed to be implemented, in order to assure the services described above, to be available very soon.

The implementation of smartphone in preventing accidents, is seen by [8] in a different way. The authors found a direct link between phone usage on driving and the car accidents. So, they proposed a "smart car system", where the vehicle speed is limited during calls. They also designed an automatic system for text messaging that contains data about the accident, being sent to emergency and, so called "victim guardians". The proposal of IVS replacement might offer a starting choice in case of old vehicles. If the eCall system is mandatory from 2017 and the European Commission expects to have a critical mass in 2020 and a full deployment in 2030, the older vehicles couldn't benefit the service. In that sense, using a smartphone connected to the car, prepared with various sensors that will automatic trigger the eCall, represents a bigger market than new car sells market for IVS vendors.

3 iHeERO updates

The core members of HeERO projects, together with new ones, covering eleven countries (Bulgaria, Cyprus, Czech Republic, Finland, Germany, Greece, Ireland, Italy, Portugal, Romania and Slovenia) formed a new consortium that initiates the iHeERO project. The consortium includes 58 commercial partners and counts 26 Associated Partners. The project budget is over 30 mil. EUR and it covers funding for the period 2015-2018.

The issues addressed by the iHeERO ("I" for "infrastructure") continue the efforts of HeERO1 and HeERO2, regarding the necessary PSAP infrastructure to realise Pan-European eCall preparation for the new member states [9]. The new items on objectives list are: eCall deployment for special vehicles (HGV, Dangerous Goods, Distance Coaches), two wheeled vehicles and PSAP Conformity Assessment.

The issue of special vehicles is important in emergency situation is quite important to size the proper rescue team. For instance, in case of an accidents, where a truck carrying living animals is involved, the dispatch of the animals is a priority. Differing from this situation, in case of Dangerous Goods, it is very important that fire-fighters to be equipped with proper extinguisher gear, suitable for the chemicals transported. There are several notorious accidents, occurred after the car crash, by explosion of inflammable materials, because fire-fighters weren't aware of the cargo content in real time.

Also, the severity of the accident could be seized knowing how many persons are potentially involved. In case of Distance Coaches, the passengers number might be transmitted in optional fields of MSD. The eCall for two wheeled vehicles, addressed before by [10], differ from a common eCall, because of triggering system. If in case of common eCall the trigger could be the airbag, in case of two wheels' vehicle is no longer an option.

All the aspects presented above, includes particularities of eCall. The special vehicles require an eCall content update for each transport, to include the type and the size of the goods carried or the number of the person who travel on long distances. For the two wheeled vehicles, the triggering systems (including vehicle and helmet or body part) is different for a standard implementation.

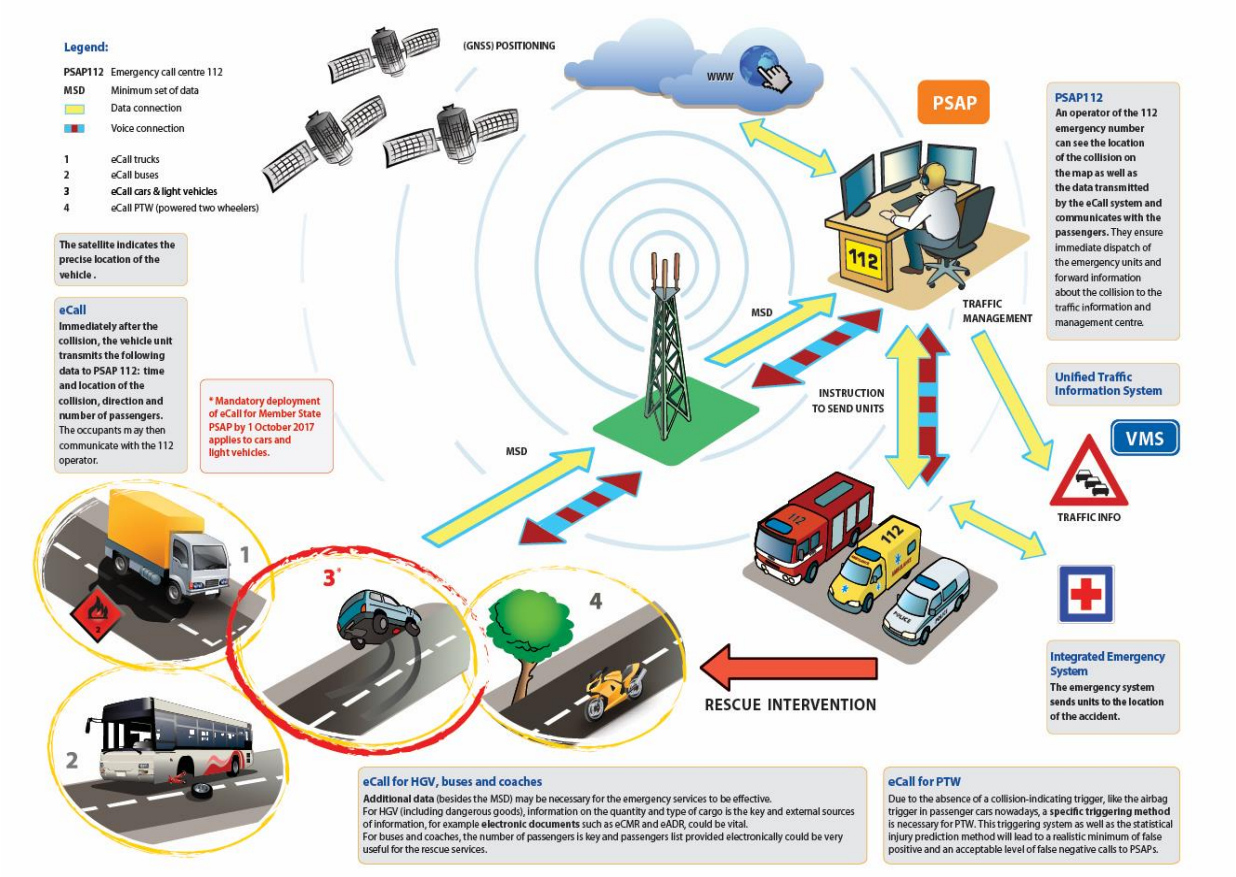

Figure 2: iHeERO description. [9]

4 Conclusions

Even eCall started as an initiative for increasing road safety, nowadays it needs to address new challenges. The continuous development of personal telecommunication devices, like smartphones, tablets, laptop shows that the PSAP have to be upgraded in order to be able to receive unstandardized calls (not using MNO or PSTN) and to be treated as emergency call. There are situations when the MNO access isn't available but it is possible an wifi connection. Also, because of recent terrorist attacks, it became obvious the link between the emergency call to other security systems (like CCTV, satellite image etc.).

The interoperability with similar systems should be also a priority. The ERA GLONASS service was tested from the period of HeERO project but still need further attention. This interoperability shows its importance when people travel between EU and Rusia or a vehicle is bought and used outside of EU. The link of actual PSAP with multimedia messages from various sources, forms the foundation for Next Generation of Emergency Service, still encountering a serious gap between the PSAP approved types of incoming calls and the personal communication devices. The EC launched in 2014 a series of funding line under H2020 RIA that hope to fill the gap.

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References

[1] G. Căruţaşu, Cz. Botezatu, C. P. Botezatu: Current status for eCall post-crash vehicle safety system in Europe, in Proceedings of 10th International Conference of Inovative Technologies, MIT, 27-29 Sept., Fiesa –Slovenia, pp. 35, 2009

[2] European Commision: eCall save lives. Digital market. Available at https://ec.europa.eu/digital-single-market/en/ecall-time-saved-lives-saved

[3] D. Dumitrescu, A. Grosoşiu, R. Ropot, V. Roşu, G. Ristea, G. Căruţaşu: Solution for eCall implementation at national level within the HeERO project – Romania case study, Paper EU-00407, The 19th ITS World Congress, 22-26 Oct., Vienna, 2012

[4] D. Dumitrescu, Gh. Oncioiu, R. Ropot, Al. Mohora, G. Ristea, G. Căruţaşu: eCall operational tests in the live system implemented in Romania, 9th ITS European Congress, Dublin, Ireland, TP 0092, 4-7 Jun., 2013

[5] M. Seidl, J. Carroll, R. Cuerden: eCall–Defining Accident Conditions for Mandatory Triggering of Automatic Emergency Calls. In 24th International Technical Conference on the Enhanced Safety of Vehicles (ESV), Gothenburg, Sweden, 2015.

[6] G. Căruțașu, C. P. Botezatu, Cz. Botezatu: Business models for extending of 112 emergency call center capabilities with e-call function insertion, Analele Universităţii din Oradea, Ştiinţe economice Tom XIX, pp. 1195-1199, Dec., 2010

[7] M. Manso, B. Guerra, C. Carjan, A. Jigman, A. Amditis, E. Sdongos, D. Donaldson: The Application of Telematics and Smart Devices in Emergencies: Use Cases in Next Generation Emergency Services. In2016 IEEE First International Conference on Internet-of-Things Design and Implementation (IoTDI) pp. 289-292, Apr 4, IEEE, 2016

[8] V. Kate, A. Karnavat, T. Ahirrao, S. Holkar: Smart Car System. International Journal of Innovative Research and Development, vol. 4, issue 2, 28 Feb., 2015

[9] iHeERO Official Website. Available at http://iheero.eu/about-iheero/

[10] S. Candefjord, L. Sandsjö, R. Andersson, N. Carlborg, A. Szakal, J. Westlund, B.A. Sjöqvist: Using Smartphones to Monitor Cycling and Automatically Detect Accidents: Towards eCall Functionality for Cyclists. In International Cycling Safety Conference 2014, 18-19 November 2014, Göteborg, Sweden, 2014.