ROMANIAN ROADMAP FOR E-CALL TECHNOLOGY ADOPTION AND FUTURE DEVELOPMENTS OF EMERGENCY SYSTEMS

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This Publication has to be referred as: Carutasu, G[eorge]; Coculescu, C[ristina] & Botezatu, M[ihai] (2017). Romanian Roadmap for E-Call Technology Adoption and Future Developments of Emergency Systems, Proceedings of the 28th DAAAM International Symposium, pp.0187-0193, B. Katalinic (Ed.), Published by DAAAM International, ISBN 978-3-902734-11-2, ISSN 1726-9679, Vienna, Austria
DOI: 10.2507/28th.daaam.proceedings.025

Abstract

Reducing road fatalities by Intelligent Transport System (ITS) implementation was an objective of EU Commission through e-Safety plan, initiated in 2004. E-call technology aims to reduce the intervention time for road accidents by sending a Minimum Set of Data (MSD), containing relevant information regarding the position, car identification, time, to nearest Public Safety Answering Point (PSAP) using mobile network. The service chain planned that after MSD is received by 112, a voice channel to be established between 112 and the car, which sent the MSD, in case of ordinary emergency calls, the call initiator being the person in emergency situations. The approaching deadline of eCall implementation, on March 2018, as free European harmonized emergency service, rise a series of technical and operational issues presented in this paper. The Romanian roadmap of e-Call technology adoption is presented, together with national and EU funded project that participated to technical and operational setting for eCall service. Moreover, the adopted Romanian pilot site solution is explained in the context of emergency system organization. Current research, regarding eCall extension to long distance coaches, heavy goods vehicle (HGV), dangerous goods and motorcycles, as result of iHeERO CEF funded project and previous research is also debated

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

1. Introduction

The statics offered by EU [1] show a significant reduction in the last ten years, for EU28. According to this source, the total number of fatalities decreased from 45 900 persons in 2005 to 26 100 persons in 2015. From this, 8% of fatalities resulted from accidents on motorways, 37% in urban areas and 55% on rural roads. Furthermore, fatalities for 2015 might be categorized on transport mode: 46% of fatalities resulted from car accidents, pedestrians 21%, moto 14%, bicycle 8%, moped 3% and other 7%. Even those numbers seem to indicate a progress on EU28 level, with 51.5 fatalities per million of habitants in 2015, it can be underlined that, in case of several countries, like Bulgaria (98 fatalities/millions of habitants) and Romania (95 fatalities/millions of habitants) remains almost four times higher than Sweden (27 fatalities/millions of habitants). If into account it is considered accumulated value for fatalities and hospitalized persons, it is emphasized that Austria reach 929 persons/ millions of habitants, the mean value for EU28 being 536.5 persons/ millions of habitants,

lowest values recorded for Ireland with 134 fatalities + hospitalized / millions of habitants. Furthermore, a sample regarding accident data and related structure is presented in [2].

Besides EU countries positions in various statistics, it is recorded an advance of overall road safety because of EU and national policies. Those positive outputs are the results of emergency services improvement and eSafety measures implementation in transportation. A closer analysis show that the fatalities rates and severity of injuries depend on road structure, quality of road, safety measures implemented into road infrastructure, cars and emergency services response time and quality. The single European emergency call number, introduced in 1991, by Council Decision 91/396/EEC remains a strong step forward, unifying all emergency agencies. 112 service reduced the response time and proper synchronize all dispatched emergency force to accident site. At that time, accident location was possible by direct interview of caller. European Road Safety Action Programme 2003-2010 introduced a series of measures that aimed to halved the fatalities resulted from road accidents. So, the action program combined measures regarding technical conditions of vehicles, transports of dangerous goods, Intelligent Transport Systems (ITS) and the eSafety initiative. The ITS Directive [3] introduced a wide range of information technologies that could be used in to increase the road safety. Related to terms definitions, ITS is referring to a suite of applications aiming to offer new services to multiple transport modes, traffic management and user to be informed regarding road safety. The Directive had four areas: optimal use of road, continuity of traffic, ITS road safety and linking the vehicle with the transport infrastructure. In addition, it is decided that the access to ITS services should be interoperable, harmonized and continuous across EU. Furthermore, it is established that the geolocation needed for various ITS applications should be able to use EGNOS and Galileo systems. From this paper perspective, eCall technology is referred as ITS service by ITS directive. Regarding traffic management, general principles of material flow are applied [4], with a detailed example in [5].

2. e-Call technology

As a single post-crash ITS service, eCall aims to reduce the intervention time of emergency teams to crash site, by accurate localization and time stamping of crash, detailing vehicle involved and severity of crash. The eCall systems (fig.1) consists into an In-Vehicle System (IVS) embedded into the car. When the accident occur, the IVS, triggered by various car mounted sensors [6] or manual, reads the current position, using a GPS module, and it is combined with predetermined Vehicle Identification Number (VIN), generating a Minimum Set of Data (MSD) message. This message is carried by Mobile Network Operators (MNO) and send it to nearest Public Safety Answering Point (PSAP). After MSD is successfully received by PSAP, it is resolved by a MSD Decoder and VIN code is extracted. Using VIN code, the EUropean CAR and driving license Information System (EUCARIS) is interrogated, resulted information being displayed directly into case file window opened by PSAP operator. In the second phase, the PSAP initiates a voice call to the vehicle, to check the nature of emergency or to obtain additional information regarding the accident. The seizing and nature of emergency team dispatched to crash site might be influenced by information obtained through voice call or the number of sensors triggered. Also, by vehicle type, decoded from VIN, it is displayed the maximum number of passengers, or vehicle type (figure 1).

In comparison to ordinary emergency call, some differences should be underlined:

- Ordinary 112 call is not supporting data exchange, and MSD should be treated as emergency call, using discriminator,
- 112 call is using MNO location or location provided by PTNO (Public Telephone Network Operators) operator for each customer, in case of eCall the location is provided by IVS GSM module,
- eCall initiates backward a voice call from PSAP to the car, which suppose that also this call should be considered as emergency call and prioritized using a discriminator. In case of 112 call, the emergency was signalized when 112 was introduced into Receiver field. For eCall, discrimination must be set into Receiver and Sender field,
- eCall supply the VIN code, additional information regarding the car and owner could be obtained by resolving EUCARIS database,
- MSD contains the time stamp of the crash and provides the moving direction (very important in case of motorways).

Fig. 1. eCall service chain – official representation

Localization provided by PTNO was addressed by [7], which also stipulates that 112 service should be available from any network and any device, including special feature regarding person with disabilities access, using text messages or other types. Highly important is that the Directive enforce the interoperability and harmonization of 112 service across EU member states. In case of localization provided by MNO, a close look is given by [8].

The eCall system (e112) was initially assessed by EU [9] in 2010. In this report, was estimated that eCall introduction will reduce the response time by 50% in rural areas and 40% in urban areas. However, the fatalities reduction is estimated between 2 and 10% and severity of injuries between 2 and 15%. Beyond humanitarian reasons, where no life can be measured and replaced, the cost of health treatment and person unavailability is taken into consideration, together traffic congestion savings, for the period 2005-2033, having a positive impact, balanced with PSAP upgrade costs and IVS costs.

As implementation deadline for eCall service, estimated first in 2010 by [10], was prolonged, having another proposal for 2015 [9] and finally to 2018, 31st of March [11] to be available for all new produced M1 and N1 vehicles (passenger cars and light duty vehicles).

3. Romanian roadmap for e-call technology adoption

The important events and actions carried out by Romania to implement eCall service started in 2007, when ITS Romania signed eCall MOU (Memorandum of Understanding for Realization of Interoperable In-Vehicle eCall). Later, in 2010, rallied to the action, Romanian Ministry of Communications and Information Society, National Company of Motorways and National Roads of Romania and Romanian-American University.

In Romania, the 112 service is managed by The Single National Emergency Call System – SNECS 112 implemented and administrated by STS (Special Telecommunication Service) established from 2006. Regarding administrative structure, Romania has 41 counties plus Bucharest. However, the STS organized a PSAP responsible for each county.

The research on eCall field started with the project “Study regarding eCall technology”, having as partners ITS Romania, Romanian-American University and ElSol, in the period 2008-2010, funded by Romanian Ministry of Communications and Information Society. The project aimed to identify the stakeholders for eCall implementation and structural updates to existing infrastructure [12]. Furthermore, the eCall operation by private operators was taken into account and presented in [13]. The main findings of research were:

- PSAP infrastructure should be updated, to receive MSD and to be integrated into existing file case software application – stakeholder STS,
- MNOs must implement discriminator flag for signaling backward call, from PSAP to vehicle that triggered eCall – Stakeholder local MNOs and Romanian Authority in Communication,
- TMC (Traffic Management Centre) should implement a data interface, to receive and post on existing software, the GNSS coordinates of vehicle crash, provided by MSD, initially received by PSAP and transferred to TMC – stakeholder National Company of Motorways and National Roads of Romania,
- VIN code resolving, by interrogating EUCARIS database in real time, using data embedded into MSD, and details presentations to PSAP operator- stakeholder STS and Ministry of Interior, Vehicle License and Vehicle Regime Direction,
- eCall service chain will include only public organization, Romania had no private PSAP and insurance company had no interest in eCall technology, accordingly to questionnaire filled in 2009.

The key findings of “Study regarding eCall technology” project become later, in 2010, objectives of Romanian Pilot Site of the project ICT-PSP / FP7 / No. 270906/2010 / Harmonised eCall European Pilot (HeERO), financed by EC. The project consortium covered various stakeholder from nine countries: Croatia, Czech Republic, Finland, Germany, Greece, Italy, The Netherlands, Romania and Sweden. The Romanian consortium was composed by ITS Romania, STS, National Company of Motorways and National Roads of Romania, UTI System, Romanian-American University and ElSol.

Additional objectives were added [14]:

- Interoperability and cross border, eCall service should be available to any vehicle that travels across EU and to transfer the emergency call to nearest PSAP, in case cross border situation,
- Harmonization, mapping and levelling the 112/e112 service into member states.

The technical solution adopted by Romanian Pilot Site (presented in figure 2), indicates that the MSD triggered by IVS, is carried by PLMN and routed to Telekom network. From this network, the call is diverted to closest EONES modules, that links Telekom to 112 Network, detailed in [15].

Using identification of eCall flag, the call is diverted to eCall modem. Further, the added B number, specific to county where eCall was triggered is replaced with specific code for Bucharest 021 112. This action is needed because Romania upgraded only two PSAPs with eCall function, primary Bucharest, and Brasov as operational backup. So, eCall enters into Multi Service Network (MSS) managed by STS and received into Bucharest PSAP. Here, MD110 PBX is used to commute to a VoIP server (Communication eXchange Environment -CXE).

The eCall is signaled to operator with a special ring, and displayed to operator console with data contained in MSD. To resolve VIN code, a query is sent to EUCARIS database. When the MSD reception is done and confirmed, the voice channel between 112 and IVS is opened. In the same time, resulted information from VIN interrogation (owner, car color, car type, maximum number of passengers, fuel type) is displayed into case file opened for the accident.

After voice call is established, the operator might interrogate the passengers, regarding further details regarding the emergency team proper seize the emergency teams. If no answer is given, the procedure details a standard rescue team dispatched to crash site. The developed infrastructure is highlighted with yellow. The test operated by STS in spring 2012, indicated a successfully eCall operation chain [16], Romanian PSAP readiness being set starting from November 2013. HeERO2 project involved six countries: Belgium, Bulgaria, Denmark, Luxembourg, Spain and Turkey, aligning countries PSAP to eCall requirements. To close the service chain, with two Romanian vehicle manufacturers, Renault and Ford, should homologate the vehicles produced from class M1 and N1, applicable from 31st of March 2018 [17]. Furthermore, the local MNO, Vodafone reported eCall readiness [18] for twelve countries including Romania, starting from 31st of March 2016. However, it is still an issue regarding how new SIM dedicated to eCall will be released and what cost model will be applied.

The impact assessment for eCall in Romania, may start by new car evolution in period 2018-2020. On 31st December 2016, in Romania where registered 7 010 608 vehicles, from which 5 470 578 in M1 category and 781 196 in N, representing cumulated 89.17% from total vehicles. Furthermore, 174 407 M1 under 2 years and 41 729 N under 2 years were registered in 2016. So, is expected that in next two years, to have 200 000 units equipped with eCall function (2.8% from total registered vehicles). From total 28 994 road accidents (in 2015) is expected that at least 50% that will trigger an eCall, reported to 2.8%, new vehicles it foreseen around 400 eCalls in each year for first two years. Also, in [9] is estimated an yearly rate of 11% of increasing the number of vehicles with eCall. Same source reveals that for Romania, is estimated a 6% diminution of road fatalities. The full implementation threshold of eCall is 2040.

Fig. 2. eCall updates for Romanian Pilot Site

4. iHeERO and future emergency services development

The iHeERO (i from Infrastructure) project started in 2015, with a three-year duration and over 30 mil. EUR as budget, financed by EU through CEF program, including members from eleven countries (Bulgaria, Cyprus, Czech Republic, Finland, Germany, Greece, Ireland, Italy, Portugal, Romania and Slovenia) continued the previous HeERO1 and HeERO2 project to align the PSAP to eCall requirements.

New objectives were added regarding eCall implementation to new categories of vehicles. In case of previous HeERO project only M1 and N1 categories were considered. Even those categories represent almost 90% of total registered vehicles, some notorious accidents, having great impact, by number of fatalities, good losses or environmental impact, the need of eCall extension to other types of vehicle was approached. IHeERO deals with, so call, special eCall, considering changes needed into the eCall service chain, presented in figure 3.

Fig. 3. iHeERO service chain for special vehicles [20]

So, in HGV case, the content of cargo should be updated for each transport, the cargo nature being signaled by MSD through optional fields. There are two situations in view to emphasize the significance of the subject, first when HGV is carrying dangerous goods, highly inflammable materials for instance, which should not be extinguished using water, and second, when living animals are carried, the animals must be embarked into another vehicle.

A new proposed section is dedicated to distance coaches, where the MSD content should be updated for each journey with number of passengers. The proper seizing of rescue teams, or red cod activation is indicated depending the number of person injured. The last special category eCall implementation is given by two wheeled vehicles. In that case, triggering eCall is impossible with standard sensors (airbag inflation), requiring a two-part architecture (helmet and body part). Such system is detailed in [19]. Also, the PSAP conformity is another objective of iHeERO. The current advance of iHeERO might be discovered in [20].

The future emergency development should consider realities of today world. Moreover, using social media environment, smartphones, video calls in ordinary conversation, must indicate a change of vision for emergency services. Besides, with a very long period from the planning to implementation risks that eCall to be obsolete before even started. So, some directions of future work could be underlined:

- Extending eCall technology for pedestrians, using a smartphone application, same information regarding incident might be transmitted to PSAP, replacing VIN code with personal number and car sensor replaced with life monitoring sensors,

- Retrofit development for old cars, including certification, the market potential for owners that wish voluntary to implement eCall,
- Further development of MNO infrastructure will allow to replace the voice call communication from PSAP to IVS with a video call and the MSD to contain multimedia message with relevant information about the crash.

5. Conclusion

Reducing road fatalities, remains an objective for EU, even the numbers halved in the last decade. The measure that should be taken by EU Commission and by the member states must envisage also the increasing of vehicle safety, like safe belt in the past, continuing with airbag displacement for rear passengers etc. Furthermore, the road quality and safety, expressed into motorways length, in case of Romania depreciate the effort of emergency services to save lives. Moreover, even Romania is a best practice for eCall implementation, the overall quality of the roads will limit the success of rescue teams. The eCall implementation should be enforced with other ITS measures, critical in avoiding and signaling dangerous situations.

After a very long journey, started with eSafety Action Plan in 2000, the eCall will become available as universal service in 2018, with an expected maturity in 2040. Moreover, with an implementation deadline prorogated several times, initially in 2010 and 2015 second, eCall passed very difficult technical and organizational issues, to align all PSAPs, MNOs, TMCs and vehicle manufactures to comply eCall standards. The HeERO projects, developed in the period 2010-2018, having a total budget of almost 50 million EUR (with 50% EU contribution), is a landmark of ITS implementation. During this period, 21 EU and associated members states participated to eCall specific activities, regarding PSAP and TMC infrastructure updates, functional and operational tests, cross border situation and cooperation with Russian similar service ERA-GLONASS. The interest of the automotive industry, MNOs and other stakeholders on HeERO projects was very high, iHeERO project alone having 69 partners (part of them being associated partners with no budget) that manifest their will to participate to project activities, iHeERO being by far the largest consortium that run a project financed by EU Commission.

Romanian expertise accumulated in HeERO1 and iHeERO, launched new opportunities for emergency services. The actual situation of terrorist attacks across Europe led to necessity of further improvement of information collection from incident site. On course projects, like NEXES, propose new methods for carrying the emergency message to PSAP, introducing the possibility of wireless communication to be accepted by PSAP and to enrich the content using multimedia files. Even the reported accident coordinates and time are accurate, the accident evaluation must be corrected using other field sources, like CCTV or satellite images, to a proper seize of rescue team.

Regarding eCall further development, the first look envisages old vehicles, being a huge market opportunity. With an estimated price of 150 EUR for IVS and moreover, the third-party services for updating and replacing IVS for special purposes (introduced by iHeERO) is another market opportunity.

The authors participated to mentioned projects and contributed to eCall Romanian pilot site development and iHeERO activities. After a decade of effort in eCall field, it is hoped that launching in 2018, eCall service to save the promised lives and to reduce cost regarding hospitalization, unavailability and traffic congestions. An impact assessment is scheduled after two years of implementation.

6. Acknowledgments

This work was supported by a grant of the European Commission, through CONNECTING EUROPE FACILITY (CEF) - TRANSPORT SECTOR program, AGREEMENT No INEA/CEF/TRAN/A2014/1031743 "I_HeERO".

7. References

- [1] <http://ec.europa.eu/eurostat> EUROSTAT (2017) Statistics – accidents data - European Commission. Accessed on: 2017-06-23
- [2] Zovak, G.; Saric, Z.; & Cop, A. (2011). Conceptual Model for Structuring Traffic Accident Data, Annals of DAAAM for 2011 & Proceedings of the 22nd International DAAAM Symposium, 23-26th November 2011, Vienna, ISBN 978-3-901509-83-4, ISSN 1726-9679, Katalinic, B. (Ed.), pp. 0523-0524, Publisher DAAAM International, .
- [3] European Parliament (2010) Directive 2010/40/EU of the European Parliament and of The Council of 7 July 2010. Official Journal of European Union
- [4] Cotet, C. E.; & Popescu, D. (2014). Material flow management in industrial engineering, In: Encyclopedia of Information Science and Technology, Third Edit., Khosrow-Pour, M. (Ed.), pp. 3786 – 3794, Information Science Reference, ISBN 978-1-4666-5888-2, United States of America
- [5] Rados, B; & Rados, A. (2016). Implementation of Multi-Criteria Decision Making in Planning Traffic Systems, Proceedings of the 26th DAAAM International Symposium, pp.0069-0074, B. Katalinic (Ed.), Published by DAAAM International, ISBN 978-3-902734-07-5, ISSN 1726-9679, Vienna, Austria DOI:10.2507/26th.daaam.proceedings.010.
- [6] Seidl, M., Carroll, J., & Cuerden, R. (2015). eCall–Defining Accident Conditions for Mandatory Triggering of Automatic Emergency Calls. 24th International Technical Conference on the Enhanced Safety of Vehicles (ESV),

- Paper Number 15-0137, 8-11th June 2015, Gothenburg, Sweden. Available from: <https://www-esv.nhtsa.dot.gov/proceedings/24/files/24ESV-000137.PDF>, Accessed: 2017-06-11
- [7] European Parliament (2002). Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive). Available from: <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:32002L0022>. Accessed: 2017-07-04
- [8] Adamek, M; Neumann, P; Pospisilik, M & Matysek, M. (2016). Using of GSM Locator in Security Applications, Proceedings of the 26th DAAAM International Symposium, pp.0075-0081, B. Katalinic (Ed.), Published by DAAAM International, ISBN 978-3-902734-07-5, ISSN 1726-9679, Vienna, Austria DOI:10.2507/26th.daaam.proceedings.011
- [9] European Commission (2011). eCall Impact Assessment | Digital Single Market. Available from: <https://ec.europa.eu/digital-single-market/en/news/ecall-impact-assessment>. Accessed: 2017-03-25
- [10] eCall Driving Group (2006). Recommendations of the DG eCall for the introduction of the pan-European eCall. Available from: https://www.trafi.fi/filebank/a/1436524683/a9892dd401033f54359ff9bb16ccb93d/18185-Position_papers_DG_eCall_v2.pdf. Accessed: 2017-07-05
- [11] European Parliament (2015) Regulation (EU) 2015/758 of the European Parliament and of the Council of 29 April 2015 concerning type-approval requirements for the deployment of the eCall in-vehicle system based on the 112 service and amending Directive 2007/46/EC. Available from: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32015R0758>. Accessed: 2017-07-05
- [12] Botezatu, C.; Botezatu, C. P.; Carutasu, G.; & Barca, C. (2009). eCall safety transportation management systems – features and capabilities. Annals of Oradea University. Fascicle Management and Technological Engineering, vol. 8, no. 1, pp. 118–123, ISSN 1583-0691
- [13] Carutasu, G.; Botezatu, C.; Botezatu, C. P.; & Pop, P. D. (2010). Business Models For Extending of 112 Emergency Call Center Capabilities With E-Call Function Insertion. Annals of Oradea University. Economic Science, vol. 1, no. 2, pp. 1177–1182, ISSN 1582-5450
- [14] <http://www.heero-pilot.eu/view/en/heero/objectives.html>, (2012) HeERO Consortium, HeERO - About HeERO Objectives. Accessed: 2017-07-05
- [15] Dumitrescu, D.; Grososiu, A.; Dumitrescu, S.; Rosu, V.; Ristea, G. & Carutasu, G. (2012). Solution for eCall Implementation at National Level within the HeERO Project–Romania Case Study, 19th ITS World Congress EU00407, 22-26 October 2012, ITS America, Vienna, Available from: <https://trid.trb.org/view.aspx?id=1264000>
- [16] Dumitrescu, D.; Oncioiu, G.; Ropot, R.; Mohora, A.; Ristea, G.; & Carutasu, G. (2013). eCall Operational Tests in the Live System Implemented in Romania, 9th ITS European Congress, TP 0092, 4-7 June 2013, Dublin, Ireland,
- [17] European Parliament (2015). Regulation (EU) 2015/ 758 of The European Parliament concerning type-approval requirements for the deployment of the eCall in-vehicle system based on the 112 service.
- [18] MacDougall, R. (2017). Recommendations on residual issues relevant to eCall, Vodafone Group Public Policy, ECC Public Workshop on numbering for eCall, 31st January 2017, Available from: https://www.cept.org/Documents/wg-nan/34819/session-3-presentation-3_robert-macdougall, Accessed: 2017-07-02
- [19] Harnischmacher, F.; Cosyns, C.; Grugl, K.-M.; Moerbe, M.; Portouli, E.; & Savaresi, S. M. (2016). State of the art assessment Powered Two-Wheeler (P2W) eCall, 11th ITS European Congress, 6-9th June 2016, Glasgow, Scotland, pp. 6–9, Available from: http://iheero.eu/wp-content/uploads/sites/3/2016/06/ITS16_State_of_the_art_assessment_P2W_eCall_FINAL.pdf. Accessed: 2017-07-2
- [20] <http://iheero.eu/>, (2016). iHeERO - I_HeERO Official website. Accessed: 2017-07-06