Role of Nomadic Devices Coupled to In-Cockpit Wireless Networks for the eCall System: Quo Vadis

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Abstract: Telematic services offer the European semiconductor and ICT industries the potential for growth by innovation. Coupled to public private partnership such as eCall, these industries should be able to profit from strong policy incentives. However, while eCall is a socially valuable service, it is not attractive enough for the major players to invest in establishing a viable system. This paper reviews the problems of eCall and attempt to show how the semiconductor industry and ICT industries can revive the concept. The paper reports on the results from the MEDEA+ project Caring Cars, and shows how partners from The Netherlands, Spain and Turkey have used the EUREKA programme in co-operation to address these complex technical issues.

1. Introduction

The vision of eCall is for pan-European immediate alert system for medical attention after road traffic accidents [1]. Implementing such a system would boost the fortunes of the electronics and semiconductor industry with systems for new telematic services in cars. However, eCall is of limited economic value to many important players that need to make the system work as planned. And although the EU is making eCall obligatory, the system won't achieve its goals for at least a decade. Nevertheless an EU wide system for medical aid/coaching services and other medical aid would be highly valued, and of immense economic value to the industry to support AAL, or Ambient Assisted Living.

This paper deals with these issues via the interests in innovation of a small band of partners in a MEDEA+ project called Caring Cars [2, 3]. The issues confronting automotive alarm systems are addressed, and the solution that the project proposes based on a general medical alarm system in a network of nomadic wireless devices is described. This is implemented for a car's in cockpit network supported by a Car PC by TOFAS, but has been extended by Mobilera and other partners to a home network and fully nomadic concept.

Telematics and Road Traffic Safety

By the progressive introduction over four decades of safety electronics and telematics in cars it is popularly claimed to have saved lives and medical costs. These claims must at least be partially true, although the role of telecommunications and medical technologies for trauma management in this period have also been swift and should have some claim to the effect on road deaths and serious injuries. Especially as car safety measures have the

tendency to increase drivers' bad habits, whereas the other technologies have no impact on drivers. The future of safety on the road must lie in better understanding of how car electronics, telecommunications and medical procedures for chronic conditions and trauma can be improved to create safe roads for all.

eCall

eCall is a system that provides an automated message from a vehicle to the emergency services following a traffic incident. This would in principle allow the emergency systems to react more coherently to traffic incidents and to deploy the right resources, in a specific time window and with the aim to

- reduce the medical costs of the incident to the people involved
- reduce the road congestion due to incidents

eCall has been criticized as a expensive solution, i.e. point solution, to a problem which due to improved telecommunication services is solving itself. However eCall has now been mandated by the EU parliament for inclusion in all new vehicles from 2011.

2. Influences on the Caring Cars Project

The Caring Cars project brings together the interests of partners in three countries to address the issue of how to bring intelligent car care to us. It is the main goal of the Caring Cars project to increase car safety by enabling wellness applications in an automotive environment. To achieve this, the project will realise an open automotive infrastructure, the basis of which will be formed by a sensor network in cooperation with a car gateway. This sensor network will consist of the sensors already available in vehicles augmented with new sensors. Minimum car gateways will establish a connection with the external world signalling for instance emergency services. In this way it will be possible to improve car safety and thus reduce the costs of transportation. However, the car gateway can also be seen as a Car PC, providing in-car services. By adding in-cockpit wireless communication to the infrastructure envisioned by the partners it will also become possible to use the same infrastructure to support health care applications such as home based AAL. .

Broad Issues and Concepts

Before the authors can describe the results of the Caring Cars project there are a number of issues and concepts in eCall that need to be described and explained

Golden Hour in Trauma Handling

The Golden hour is a concept in trauma care. Post trauma (accident) there are three periods in which death occurs: immediate, early, and late. The golden hour, from a medical emergency perspective, is the second peak that occurs within minutes to a few hours following injury. It is a well established fact that the victim's chances of survival are greatest if they receive care within a short period of time after a severe injury. The "golden hour" is not a rigidly defined time frame. Rather it is the core principle of rapid intervention in trauma cases, specifically those who suffer blunt force trauma, where death by internal or external bleeding is a significant cause of loss of life. Air bag systems and other features should focus on reducing the first peak trauma fatalities from acute heart and respiration conditions, and then the second peak i.e. blunt force trauma effects with profuse bleeding.

Death due to other causes, drowning, fire, or smoke are rare in statistical terms, thus beyond a technical solution.

eCall Economics

The economics of eCall are based on the assumption that an automatic call of the location and nature of an incident can reduce human suffering and provide an economic benefit. It is assumed that there are two benefits from eCall:

- Consistent and swift medical attention to road traffic incidents to provide care with the Golden Hour
- Reduction in road traffic congestion due to fewer road traffic incidents,

Economics of Acute Medical Attention for Trauma

Although the idea of consistent and swift medical aid is an appealing concept, the implementation via eCall of such a service has been consistently challenged by many parties. The main issue here is the economic advantage, advanced GSM telecommunication and road monitoring implies that public authorities are warned of accidents very rapidly. This is especially so for the majority of the major roads at peak times. Hence eCall is a redundant system. This technical redundant is compounded by the fact that a road traffic fatality is a very cheap outcome for the society as a whole, as the immediate economic cost of death is low. Serious injury is a greater cost to society, i.e. cost of medical care and rehabilitation. Nevertheless the greater part of the economic loss is borne by the individual and their dependent families. In fact taking the UK as an example the net benefit to the UK government of eCall would be less than 1600 million pounds over the first decade, while the costs are between 2000 to 9000 million in the same period. And for this reason public authorities are looking for the users to pay for the cost of eCall [7]. On the face of it a strange policy decision in economic terms.

However, for the automotive industry the prospect of users facing a high price for cars for a safety feature which does not improve actual car safety is an issue. Especially as a similar investment in other proven electronics safety features would have a greater impact. Moreover, eCall as proposed is an impediment to proprietary system for complete telematic services, such as GM OnStar service in the US [8].

Summary on eCall

eCall is a populist move by the EU, unfortunately it is too narrowly defined to be useful in all but a small set of medical conditions, and the usefulness for road traffic congestion management cannot be effectively handled by a system focused on emergency calls only triggered by air bag deployment. The lesson in failure on eCall's deployment has to be learned by looking across the Atlantic to the success of the car PC of the OnStar from GM [8] or to step beyond eCall to MySOS. In summary, eCall is a popular proposal with the population, but fails to unite the economic interest of the actors to the main goal of providing acute medical care for those unlucky few that need it

Prior to the start of the Caring Cars project in 2006 Philips and NXP had made an analysis of eCall as proposed by the EU [9]. And a number of scenarios for the future of eCall were discussed with policy makers. This analysis was made public via the University of Utrecht.

Given that the penetration of mobile phone is close to 100%, and the cost of customizing services to users is low, then all mobile phone should be adapted to monitor the risks of accidents and instigate the service needed by the individual for medical and social care. This service is dubbed MySOS, and as minimum provides a one button call to support both clinically chronic conditions and acute incidents faced by a person in daily life. Logically a MySOS service should provide basic cognitive capabilities in the phone to detect major trauma incidents such as a car crash for itself, or be informed of such an incident by its local network. Then the MySOS function of the nomadic device covers the eCall functionality as part of a broad range of responses to medical conditions specific to the individual.

In Cockpit Wireless Networks

When eCall was conceived in the 1990s, the idea of a car being part of open or closed wireless networks was hard for the policy makers and general public to understand. However, in the decade since the use of Wi-Fi and Bluetooth networks has grown rapidly, and the idea of linking at least the media sub-system of the car to a mobile device is readily understood. Moreover, the OEMs provide this option even in low price cars, such as Blue&Me [9].

3. Objectives of Caring Cars

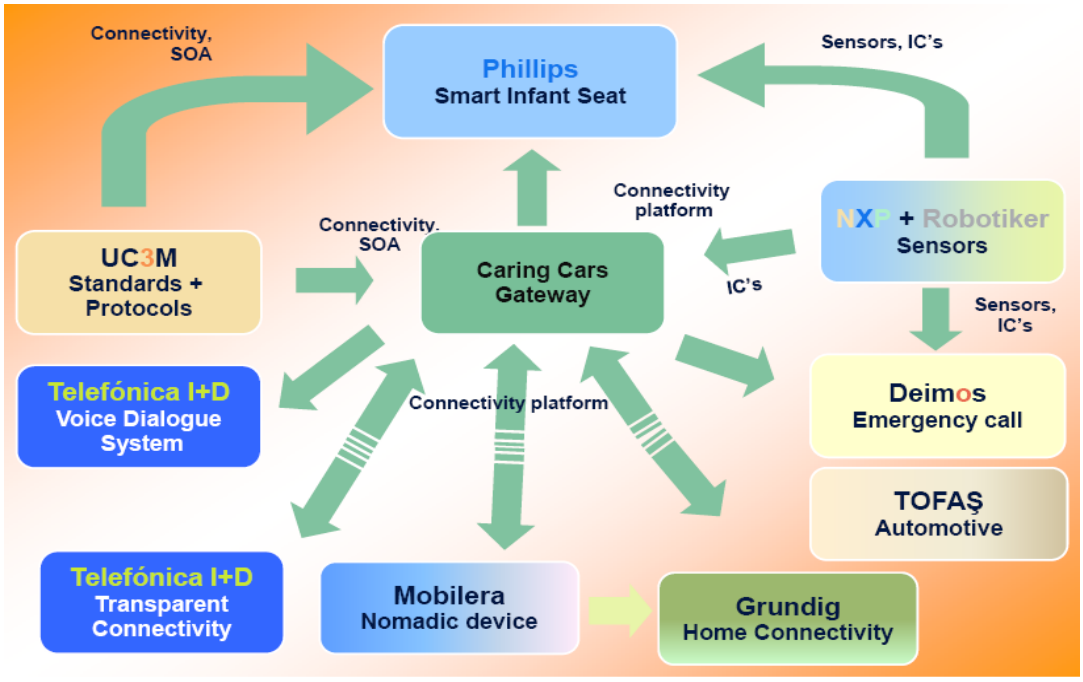

Figure 1: Global Vision of Contributions to Caring Cars Project

The Caring Cars project's main goal is to increase car safety by enabling wellness applications in an automotive environment. The vehicle has the main processing unit Car gateway communicating with in-car sensors to control the internal environment and also provides the voice interface to the driver. The second important aspect of the car gateway is to communicate with the remote emergency services in case of an accident or a special situation reported by other nomadic devices such as nomadic infant seat reporting the ECG problem in infant. Figure 1 shows the global picture of the project with respect to the partners' roles. Car gateway is a central point of contact or gateway for wired and wireless

ad-hoc networks for nomadic devices in the cockpit. Devices connected to the Car gateway communicate with each other through Car gateway to shares services as show in Figure 2.

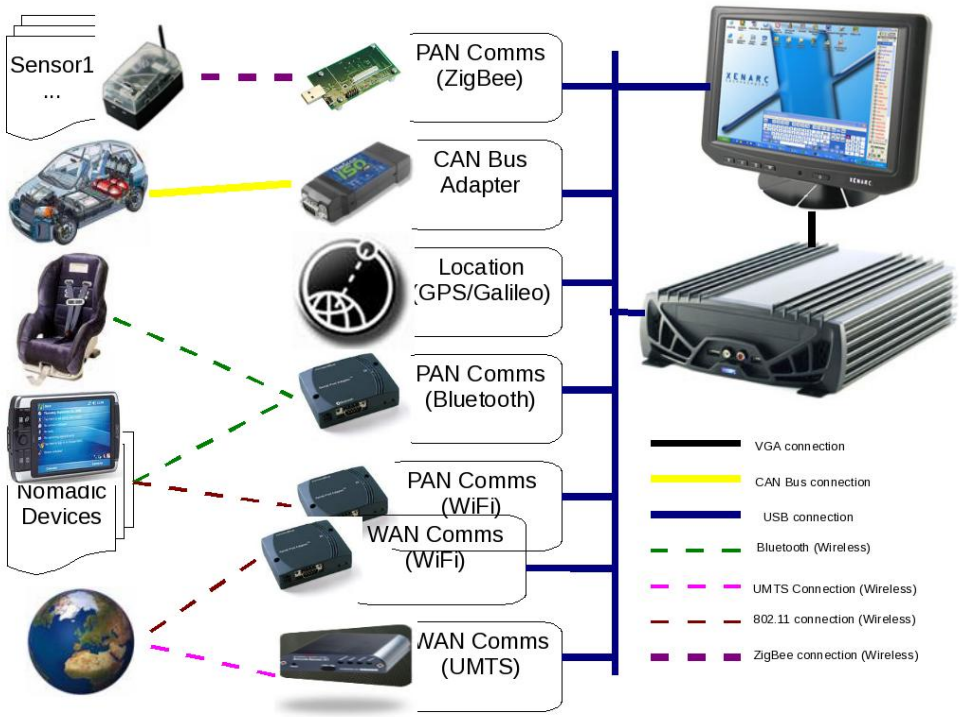

Figure 2: System overview of Caring Cars Networks

One of the applications within the Caring Cars project is the nomadic infant seat. The Nomadic Infant Seat (NIS) subsystem is designed with the consideration to communicate not only with the Car gateway but also to communicate with other nomadic devices. The term nomadic device is used for handheld wireless devices such as PDAs allowing carers to monitor the baby. Currently, connectivity interfaces Wi-Fi, Bluetooth, Infrared have been added to many consumer electronic devices like digital photo frames, and IP TVs. so the NIS can communicate with various devices found in home environments as well. Figure 3 shows the generic behaviour of the NIS device that communicates with the sensors; data processing and communicates with external devices. The NIS is designed as a sub-system to be a nomadic MySOS system for the baby, and can detect physiological, emotional, and environmental states that could cause an Alarm state. In conjunction with the Car gateway this could trigger an eCall with information on the situation provided by the NIS or the Car gateway.

In MySOS mode the NIS monitors three domains

- Physiological conditions: heart beat, body temperature and breathing
- Emotional state : Sleeping, waking, crying, seeking attention by eye contact,
- Environmental conditions: ambient temperature, movement, crash detection, secured fastening, battery state, human carers attention (local/remote)

Dependent on the availability of a human care giver, the NIS can communicate with the Car gateway to raise alarm levels from SMS messages to trusted care givers in the locality, to engaging car warning lights, to finally transmission of an eCall, i.e. in an acute situation with no response from a local care giver. Physiological data, giving the state in the golden period (from minutes with no heart beat to an hour i.e. periods left alone without any

environmental threat, i.e. hot cars are deadly) for acute aid calls to the level of alarm priority.

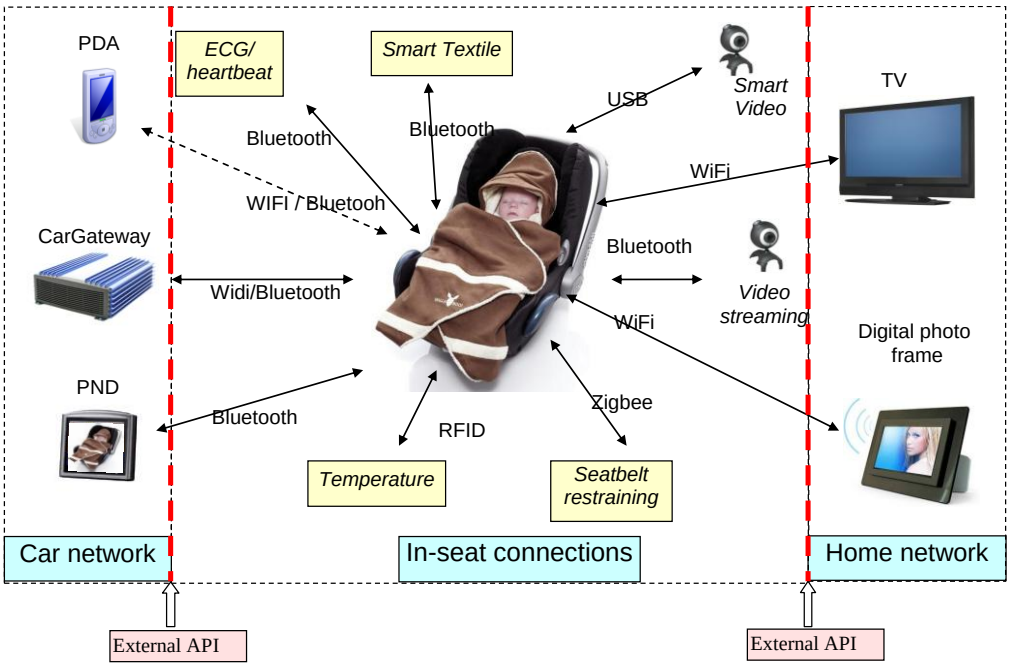

Figure 3: Baby Seat NIS as MySOS Device

The NIS is seen as an example of a cognitive system operation for MySOS, and a generic architecture for such a MySOS device based on an OSGi (Open Open Services Gateway Initiative) framework [10] is given in Figure 4. In a home situation, a home gateway would replace the role of a Car gateway as a service platform under Java but providing UPnP services.

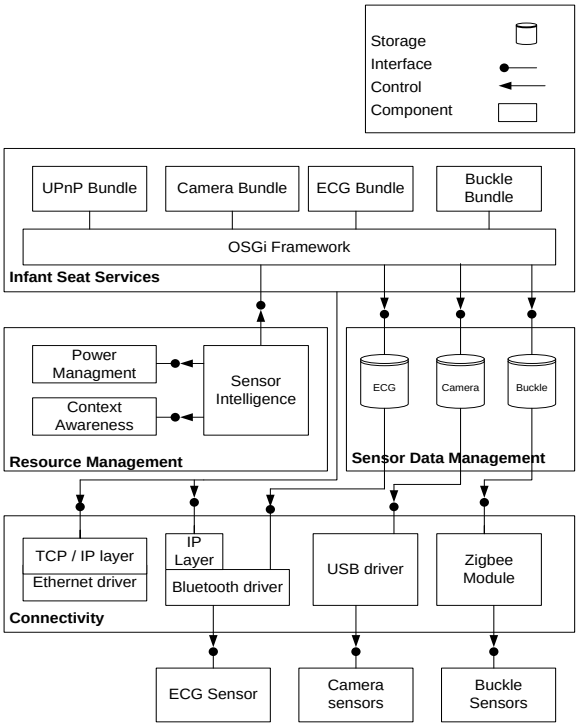

Figure 4: Generic framework for MySOS device used in NIS based on OSGi

4. Development and Future Perspective

MySOS Devices

The baby seat is considered a very good example of a MySOS device. Children of this age cannot be expected to use a mobile device, but the baby seat gives an example of how cars can be enhanced to provide care services to parent and child.

Car PC or Gateway

Initial EU legislation for the eCall demanded a black box with a special but limited functionality for the e112. And while some progress has been made in the signalling to the PSAP the functionality of the eCall box is still too limited to be economically viable. And will be overtaken by MySOS devices.

Nomadic Devices

The open automotive infrastructure that Caring Cars envisions can be a solid platform for developers. Various hardware components using the underlying platform can be developed. Software applications running on nomadic devices can also create a market for future development. Various services can be offered using nomadic devices, such as location-based services using GPS, proximity and ambient light sensors, accelerometers and pedometers.

In-Car Networks

The need for in-cockpit wireless communication is very broad. The current technologies for wireless networks such as Wifi and Bluetooth are in the process of adaption to various needs on the road. However, while these technologies offer established and low cost implementation they are not ideally matched to the application that will enhance eCall and other telematic services. Cost, integration issues (Smart fabrics), and power consumption is still a major issue. Energy harvesting is not likely to produce the power needed for these wireless standards, even if the designs are adapted to the short range communication involved in a cockpit. Standards such as continua focus on Bluetooth/Zigbee and USB for the car situation RFID to allow communication for the purposes of monitoring. It offers a business opportunity for the European semiconductor industry.

5. Conclusions

First conclusion is that a simple eCall Black box must be implemented as a function of an open platform for other telematic services on a car. eCall is a popular concept, but it is not economically viable as a service for all vehicles. In fact focusing on the problem of road traffic deaths and serious injury; a better solution would be to provide young high risk drivers on rural road with an in-cockpit device i.e. MySOS. In fact MySOS is economically much better solution than to wait a decade for older cars used by such drivers to be equipped with eCall.

Second conclusion, MySOS devices such as smart infant seat, and smart driver seat with wellness function; deal not only with acute incidents, but also with chronic conditions which are the main cost in social and clinical care. A secondary issue here is that MySOS devices need not just be for healthcare, but could cover other social issues, such as road attacks on haulage drivers.

Third conclusion is that a Car gateway is a useful function for OEMs to providers of additional services to road users, and that the Linux is a good open platform.

Fourth conclusion, nomadic devices integrated with the open car platform provided can create a market for various applications. New generation intelligent device platforms like Apple's iPhone and Google's Android can provide a good framework for application development.

Finally in-cockpit networks need to be secure and low power. Although video functionality is necessary in some functions, such as the Smart infant seat, most of the communication is low bandwidth, and RFID could provide a good solution for many applications, especially where the gateway and MySOS devices must network. For in-cockpit networks the physical location of the devices is easy to establish and antenna for networks in the cockpit would be cheap to optimize.

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