PROJECT PROFILE

A409: Secured architecture and protocols for enhanced car safety (SAPECS)

AUTOMOTIVE ELECTRONICS

Partners:

AMIS
Atmel
CS
Valeo
WCT

Project leader:

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Key project dates:

Start: January 2004
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Countries involved:

Belgium
France
UK

Passive safety devices, such as airbags, and antilock braking systems are now common in cars. Next-generation accident prevention will involve automatic or semi-automatic systems to warn of the imminence of a crash or, ultimately, take control of a vehicle to avoid collision. However, this is only acceptable if the reliability of all control units is absolute. The A409 SAPECS project is focusing on safe data processing in these modules and ensuring fail-safe intercommunication networks between the modules. It will establish consensus on electronic architectures and ensure robust device implementation to ensure even the lowest-cost cars in Europe are able to meet tomorrow's safety standards.

According to the Community database on accidents on the roads in Europe (CARE), more than 30,000 people die or are injured in car accidents every year in Europe. To overcome this fundamental social issue, carmakers in association with infrastructure authorities are developing new electronic systems capable of providing vital input to the car's intelligence.

On-board metrology and the ability to transmit data relating to accident warnings, emergency localisation and crash-avoidance transmitted to in-car receivers opens the door to automatic or semi-automatic systems able to take appropriate countermeasures.

Intelligent electronic systems are also being explored by the global automotive industry for a growing range of other safety-critical features as well control of key driving, comfort and engine-management functions. To achieve absolute reliability for all such applications, the individual modules must be capable of assured, error-free communication.

Shared objectives

Prime objectives of the MEDEA+ A409 SAPECS project are to determine how silicon devices can meet the communications needs of such networks, and how safe data processing can be ensured within individual modules. The targets to develop are:

- Passive safety elements in cars;
- Fault-tolerant/fail-safe error signalling;
- Fault-tolerant architectures in control electronics; and
- Non-ambiguous human-machine interfaces.

Resulting road safety concepts, prototype systems, prototype chips and intellectual property (IP) will form a solid basis for advanced product development.

SAPECS is also verifying the ability of time-triggered technologies to satisfy the safety requirements of so-called 'X-by-wire' applications. This is essential as vehicle makers replace hydraulic or mechanical actuators by electronics. Autonomous functions such as brake-by-wire and steer-by-wire could provide valuable assistance to drivers in hazard situations, but raise major new safety and reliability questions.

European companies are very active in proposing protocols capable of high reliability and intrinsic fault tolerance – such as controller area network (CAN), time-triggered communication on CAN (TTCAN) and now

FLEXRAY. Indeed, FLEXRAY, which offers the high data transmission rates and security required by advanced automotive control systems, has become the *de facto* industry standard in Europe, supported by major automotive companies and chipmakers.

Overcoming constraints

Attention will be focused on the constraints brought by new technologies in the field of driving assistance and road safety. Particular attention will be paid to verify the requirements arising with co-operative road safety communication systems, analysing how existing and emerging standards can connect modern cars' equipment together.

At present, there remains a lack of co-ordination in addressing these issues. The results of SAPECS should help to provide a European consensus. Moreover, they could also prove of value to the avionics and space industries, for which safety and fault-tolerance are also of vital importance. Although aircraft and satellite builders have so far produced their own dedicated systems, access to lower-cost technology developed for mass-market applications could bring substantial cost savings.

IP developed in SAPECS will make it possible to interconnect communication systems using FLEXRAY while considering fault-tolerance and fail-safe criteria as the most critical goals. To verify the correctness of the fault-tolerance of systems built with the IP, a time and fail-safe critical application demonstrator will be developed and tested.

Holistic approach

SAPECS is innovative in adopting an approach that looks at road safety in its entirety.

First, it is considering broadcast technologies between the information-gathering infrastructure and modules installed in the vehicles themselves. While many radio transmission protocols can meet the safety requirements, these are being reviewed to select a system with sufficient transmission security and robustness. The reliability and security improvements resulting from this study will also be directly applicable to vehicle identification and positioning for activities such as toll collection and theft detection.

In-car information transfer over hard-wired buses is being analysed and protocols compared. The goal of SAPECS is to define, manufacture and test protocols associated with a common set of processors and microcontrollers, and will make use of the results of the MEDEA+ A404 SSAE project. Chipmaker participants will obtain proven IP for the definition of further complete modules with significantly improved robustness, enhancing European industry's ability to compete against its US and Asian rivals.

Finally, the partners are assessing architectures in terms of complexity, fail-safety and cost. The programme will treat the computing performance of the modules and propose appropriate silicon solutions.

Real-time software properties will be analysed both in theory and during the demonstration phases of the project. Should performance prove unsatisfactory, development tools will be improved to meet the safety requirements – but final optimisation could extend beyond the end of the project funding period.

Analysis of front-end modules – such as radio frequency (RF), imagers and captors – and line drivers, plus the investigation of failure mechanisms, forms a significant part of this study of the total communications flow. Because existing quality tools and techniques do not cover all aspects required by a global road-safety system, new capability is being developed to assess failure robustness at both device level and system level.

Cost-effective solutions

Based on the results of the project, the semiconductor partners plan to develop products that offer module manufacturer participants rapid prototyping platforms for evaluation and testing of new safety applications.

Independently of the technical content and functionality of these modules, the selection of market-recognised fail-safe protocols will allow automotive manufacturers to access off-the-shelf boxes that can be grouped to form scalable and cost-effective proven fault-tolerant architectures. Standardised interconnectivity will enable assembly of flexible combinations of elements tailoring safety provisions according to car category.

Standardisation will also reduce the time and cost burden of future developments, as research will be able to concentrate on new functionality, without the need to consider connectivity and protocol choices.

As well as reducing the number of deaths and personal injuries on European roads, SAPECS' results will be visible to carmakers and public authorities around the world, bringing further business opportunities from which European industry can profit.

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