CATRENE
Cluster for Application and Technology Research in Europe on NanoElectronics

PROJECT RESULTS

CAT311 | Consumer electronics' upgrade speeds up implementation of innovative automotive electronics and cuts costs through mass production [TRACE]

The Technology Readiness for Consumer Electronics (TRACE) project developed a design methodology and associated processes to help convert, qualify and release low-cost, mass-produced consumer-electronics components for automotive purposes. It also created demonstrators for highly-automated driving and autonomous infrastructure interaction. Crucially, future products are already being designed, aiming at faster development with lower costs and improved properties.

Semiconductor components provide practically all new functions needed in the automotive and industrial-automation industries, such as highly automated driving, connected vehicles, advanced driver-assistance systems, but also co-operative production and human-machine interfaces. However, the semiconductor market is largely driven by the consumer-electronics (CE) sector, which offers opportunities for much higher volumes than the automotive electronics (AE) or industrial automation ones, and thus offering higher and faster returns of investments.

So, what is the way around this problem?

Upgrade methodology and tools for automotive electronics

A logical response is to 'upgrade' the semiconductor processes and underlying technologies, not often qualified for use in automotive. With that in mind, TRACE's key objective was to develop semiconductor manufacturing processes and tools that would cut costs and speed up implementation of innovative electronics in the automotive industry. It sought to break new ground by adapting low-cost, mass-production techniques used to produce semiconductor components for CE devices to the high safety and reliability standards required for vehicles.

Besides activities on semiconductor process, component and package level additional measures were investigated and established on system hardware, software, and testing and qualification level. This allows to mitigate risks and identify effort- and cost-optimized solutions along the complete supply chain.

To this end, a design methodology (the TRACE methodology) and associated processes were developed to upgrade, qualify and release low-cost, mass-produced CE components for use in automotive. This complete, methodical framework optimises the design of the electronic control unit (ECU) – which incorporates CE semiconductor components – in order to enhance its capabilities to a level needed in individual automotive applications. The corresponding design-flow was also implemented using a database-supported toolset. In addition, knowledge gained from demonstrator optimisation was deployed to identify general, strategic and long-term areas of action. TRACE initiated a global network, along the electronics supply chain. Contacts with many different committees were established with a spectrum from lobbying and networking (e.g. within IPC, ECPE, AEC, EPOSS, SEMI, ...) to contributions to standards and best practice (e.g. within IEEE, JEDEC, ZVEI, ...). TRACE initiated an expert group within VDE-ITG (MN 5.7 "Platform for automotive semiconductor requirements along the supply chain") with the target of standardization of the TRACE methodology and its sustainable global establishment. The Global Automotive Advisory Council of SEMI sponsors the initiative, thus bringing it to international level.

In addition to the development of guidelines for CE technology readiness, the TRACE methodology also contains approaches to lifecycle aspects of products and systems. The results of the lifecycle-analysis guide (a starting point for further research in this area) showed that data transparency in this domain is limited. Preliminary results also show that the use of a rare resource (like e.g. tantalum) immediately leads to higher environmental impacts.

Central to this project was the use of CE components in a safety-critical environment. It was shown that test methods used to ensure the functionality of CE electronics in safety-relevant systems had to be adapted according to system requirements. Unavailability or late availability of tested components can hinder developing safety-relevant functions. TRACE worked on test methods that helped to circumvent this situation. Components can be tested within a system-like setup during development, thus improving test coverage, and allowing to lower the overall effort. This, in turn, should have a significant impact on the overall development time.

Several demonstrators for highly-automated driving and autonomous infrastructure interaction were developed, and the functionality of systems using components adapted for AE demonstrated were tested and validated. The Detection and Ranging Demonstrator focused on the car implementation and first-test drives. The Navigation Demonstrator compared the results of CE components with an

PROJECT CONTRIBUTES TO

- Communication
- Automotive and transport
- Health and aging society
- Safety and security
- Energy efficiency
- Digital lifestyle
- Digital technology
- Sensors and actuators
- Process development
- More than Moore

PARTNERS

Robert Bosch GmbH (CO) / AKKA Technologies / ams AG / Berliner Nanotest and Design GmbH / BMW AG / Catena / CEA / Chemnitzer Werkstoffmechanik GmbH / Continental / Coventor / Daimler AG / Delft University of Technology / FH Johanneum / Fraunhofer-Gesellschaft / FRT GmbH /Goepel electronic GmbH / Heliox / iMAR Navigation GmbH / Imsys AB / KTH Royal Institute of Technology / Nexperia Germany GmbH / NXP Semiconductors Germany GmbH / NXP Semiconductors Netherlands BV / QRTech / Rise IVF AB (formerly Swerea IVF AB) / Siemens AG / Smile (formerly Open Wide) / STMicroelectronics Grand Ouest / STMicroelectronics Grenoble / STMicroelectronics SA / Tronic's Microsystems (TDK Tronics) / TWT GmbH Science & Innovation / Université Bordeaux / University Bremen / University Siegen / VEDECOM / Volkswagen AG / Volvo Car Corporation

COUNTRIES INVOLVED

- Germany
- Austria
- France
- Netherlands
- Sweden

PROJECT LEADER

Andreas Krauss
Robert Bosch GmbH

KEY PROJECT DATES

11 April 2016 - 10 October 2019

AE reference system. Several concepts for improvement of performance and risk mitigation were successfully demonstrated. Both demonstrators were tested in lab but, importantly, also on public roads with different driving manoeuvres. A key part of the Intelligent Infrastructure Demonstrator was the design of a sensory system for the surroundings. A capacitive sensor skin was geometrically and electrically adapted to a robot system, measures for risk mitigation were implemented and intensive testing followed. Finally, the Security Demonstrator focused on the security-relevant automotive-communication application in future C2X and C2C communication systems. Test and validation procedures were jointly used to verify this application's security credentials.

Notably, several project partners are already using the TRACE methodology and associated processes to develop future serial products, which are expected to benefit from a faster development time, lower costs and improved inherent properties.

Societal and environmental issues

Innovations – such as advanced infotainment and navigation systems, internet connectivity, vehicle-to-vehicle and vehicle-to infrastructure communications and advanced driver-assistance systems – offer multiple benefits. They can help improve traffic flow and reduce congestion through the use of sensors and communications that allow for cooperative driving and predictive traffic-management. This will not only help optimise the use of available road capacity; but it will also improve the quality of life and the environment.

In addition, intelligent traffic-systems will provide integral system solutions towards road-use and energy efficiency, as well as, road safety. Furthermore, with the introduction of electronic systems for safe and autonomous driving, passive safety-measures will be replaced by active ones, resulting in reduced weights of cars and therefore lower fuel consumption and CO_2 emissions. And sensors, such as radar- cameras and the like, will create a safety bubble around the car and reduce traffic incidents.

Driving the automotive industry

Besides covering the necessary modifications and adaptations, the TRACE methodology identified ways to verify that the resulting components, technologies and integrated systems are fully safe and reliable for automotive use. Supporting innovation in the European automotive industry, TRACE brings together the entire value chain – technology provider, semiconductor manufacturers, system integrators, major automotive companies, SMEs and research partners.

The project's business goals are to:

- Allow ground-breaking automotive applications to be developed without the need for automotive-grade components;
- Reduce the time required for innovative system-integration in automotive applications by roughly three years;
- Reduce the cost and time to develop qualified semiconductor components by up to 50%, compared to today's dedicated automotive semiconductor development cycles.

These innovations are also crucial to the continued competitiveness and growth of the European automotive industry, which grew by 8% CAGR in the first quarter of 2017, represents 11% of European manufacturing jobs and exported 6 million motor vehicles equivalent to a 84 billion € trade surplus in 2018, according to ACEA (European Automobile Manufacturers Association) figures. Furthermore, MarketWatch reported in September 2019 that the automotive electronics market is expected to reach 490 billion US$ by 2026. Significantly, innovations in vehicle architectures and systems enable a high-end driving experience, that will sustain automotive-electronics market growth, as well as manufacturing and use of electric vehicles (EVs) in China, North America, and Europe.