PROJECT RESULT

Technology platform for next-generation core CMOS process

MEDEA+

2T201: Non-volatile embedded memory for systems on silicon (NEMeSyS)

Reprogramming and configuration features enhance sub-100 nm CMOS chips

Development of competitive technology to cut the time to validate and industrialise novel non-volatile memory cell concepts and processes was the main objective of NEMeSyS. The project encouraged close co-operation between European chipmakers and research centres on reuse of existing technology platforms for industrial validation of new concepts and processes. Benefits included on-chip reprogrammability and configurability, particularly in sub-100 nm CMOS technologies. This provides a boost to European leadership in smart cards and encourages advances in the key automotive electronics market.

Embedded non-volatile memory (NVM) is increasingly in demand with the continuous development of complete system-on-chip (SoC) devices. Inclusion of flash memory on chip provides a cost-effective means of meeting the requirements of a wide range of products using a smaller number of individual chips.

SoC devices are designed to satisfy specific user requirements. This limits production volumes, conflicting with cost-efficient mass production. However, with programmable NVM on-chip, the same device can be readily adapted to different applications so increasing the added value of new SoC products. This is essential to enable European designers to use lower cost manufacturing facilities that have traditionally placed their emphasis more on products with standard technologies.

Previously, embedded NVM solutions were only available in standard 130 nm CMOS technologies and above. With the development of a leading-edge 90 nm technology node and through the initiation of research and development on future embedded NVM concepts for technologies around 65 nm, the MEDEA+ 2T201 NEMeSyS project has advanced the competitive status of European production in global markets.

In addition, most of the industrial partners have already started preliminary activities at 65 nm and even at 45 nm, up to the definition of the target design rules, based on the same kind of architecture that has been developed at 90 nm.

Strengthening Europe's position

Chip-based smart cards and microcontrollers for the automotive industry are major markets for embedded flash memory. This corresponds to annual revenues of more than €1.5 billion for European chipmakers.

The smart card market is currently dominated by Europe with NEMeSyS partners holding a 60% market share but at least one Korean competitor has quadrupled its market share over the past six years and continues to increase market share. Success in NEMeSyS is therefore crucial in defending Europe's leading position in smart cards.

US and Japanese chipmakers dominate the automotive microcontroller market, worth €3 billion in 2007; the market share of the NEMeSyS partners in this segment is just 18%. The automotive market is of utmost importance for Europe's economic strength, and microelectronics are a key driver of innovation in the sector. It is therefore important for Europe to build a strong position in automotive electronics – and microcontrollers play a key role in the future challenges of energy effectiveness and reduction of CO_2 emissions.

Partner roles were divided into two categories with the chipmaking partners focusing on next node development and providing professional infrastructure for the characterisation of innovative models and concepts. The research partners concentrated on previously unexplored R&D in the area of new memory and module concepts.

Co-operation between European embedded flash memory specialists has a long history. The MEDEA T502 project extended the functionality of high-density 0.35 µm CMOS technology with embedded NVM and analogue circuitry, the MEDEA T552 project incorporated more embedded memory in baseline technologies from 0.35 to 0.18 µm, and the MEDEA+ T123 CRESCENDO project brought geometry down to 0.13 µm.

NEMeSyS has now made possible 90 nm structures and is the fourth MEDEA+ project involving some of the same partners and amounts to more than ten years of experience in similar types of co-operation. And activities have started to set up a project for future embedded NVM nodes.

Consumer benefits

The 90 nm embedded flash technology node was fully developed up to production readiness in the MEDEA+ project. The first products are already available and will soon become a standard feature of many applications, such as smart cards and automotive microcontrollers. STMicroelectronics was the first company worldwide to implement 90 nm embedded flash technology. All the industrial partners expect to have this technology in production by the end of 2009.

For the consumer, the benefits will be apparent in terms of better performance for lower cost. One example of this will be further reduced CO_2 emissions from combustion engines controlled by on-board systems that are equipped with the next generation of chips based on 90 nm embedded flash technologies.

Corresponding benefits for members of the project consortium will mean that European embedded flash semiconductor suppliers are able to maintain their leading positions in flash memory application markets – the next challenges, 65 nm, is being tackled in an upcoming CATRENE project.

Considerable opportunities

Although the main target markets are smart cards and automotive microcontrollers, considerable opportunities are expected to open up in other areas. However, in the immediate future, automotive microcontroller applications will include domains such as: power train – engine and gear-shift control; safety – anti-lock braking systems (ABS) and airbags; body and comfort – seat controls, air conditioning and electric window controls; and infotainment – car radios, DVD players and GPS navigation systems.

Smartcard applications include SIM cards for mobile phones, electronic passports, pay TV and contactless applications such as radio frequency identification (RFID) and entry control cards.

Overall, the NEMeSyS project has been a considerable success for all of the partners. In addition it managed to be the first in industry to demonstrate high dielectric constant (high-k) interpoly dielectrics at product level in terms of functionality as well as reliability, so scoring another European leadership point.

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Infineon Technologies
NXP Semiconductors
STMicroelectronics

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KEY PROJECT DATES:

Start: January 2005
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COUNTRIES INVOLVED:

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MEDEA+ focuses on enabling technologies for the Information Society and aims to make Europe a leader in system innovation on silicon.