Project result

Cluster for Application and Technology Research in Europe on NanoElectronics

CA104 | Regular array of processors boosts performance and reduces design times and costs significantly [COBRA]

Process variability, lack of flexibility, excessive design-cycle times and unacceptable costs were key issues impacting conventional hardwired-based system-on-chip architectures, and which triggered the COBRA project. Its objectives were to develop and experiment with an open, flexible and high-performance platform deploying a regular array of processors, and driven by automotive, radio and video benchmark applications.

At the time, excessive design cycle times – close to two years – and relatively high costs were constraining hardwired system-on-chip (SoC) architectures and their effect on marketing potential. Furthermore, process variability was not yet well addressed for 32nm nodes and smaller. At the same time, however, massively parallel processor arrays were being used in high-performance embedded systems, and for hardware acceleration in desktop computer and server applications, such as video compression, image processing, medical imaging, network processing, software-defined radio and other computer-intensive streaming media applications.

Wide-ranging applications

With this in mind, the COBRA project was launched to define, design, assemble, and test an open, flexible, high-performance platform, based on a regular array of processors. Homogeneity was guaranteed by the architecture and by the use of a single type of processor, in contrast to heterogeneous hardware/software solutions. COBRA's main objective was to reduce the time and cost of the SoC design phase and thus provide European manufacturers with a strategic advantage.

The main result was a processing array hardware accelerator in 28nm CMOS technology that combines flexibility and performance, and which comprises four clusters comprising 17 processors. Hardware elements in this 'computing fabric' are connected through a network-on-chip (NoC) device and linked to the SoC host subsystem, together with 3D- graphics-rendering support hardware, data and instruction caches, interfaces to cameras and liquid crystal displays. This multimedia-oriented demonstrator is capable of running telecommunications, video and multimedia benchmark applications. Other COBRA techniques were demonstrated on mobile telephony (such as LTE receiver/transmitter) or automotive applications (like pedestrian detection).

Tool-kit eases and accelerates parallel programming

The COBRA platform also resolved other issues. It can control and fine-tune energy-consumption and – for a given application – help achieve an optimal power-performance trade-off. It allows for easy prototyping, especially with embedded software development: development time and effort to build and program parallel-processed applications are reduced through the use of three very fast simulation/emulation platforms – TLM, RTL and FPGA. These platforms also allow various architectural choices to be configured, tested and experimented with, largely made possible through the use of inter-processor communication that drastically increased performance.

Application-development time was further decreased through a tool-kit which assisted firmware developers to deal with inherent complexities of parallel programming. This tool-kit makes possible generating, debugging and mapping tasks to be carried out on available computing resources.

Complementary European partners

The project consortium involved two major European chipmakers and their partners. Usefully, one project member provided chips for a wide spectrum of digital consumer applications. Consequently, COBRA can considerably reduce

Partners:

ACE
CAPS Enterprise
CEA-LETI
CEA-LIST
Compaan
Ecomunicat
NXP Semiconductors
Sapec
ST-Ericsson
STMicroelectronics
Synopsys
Technical Uni Delft
Technical Uni Eindhoven
Tedesys Global
Universitat Autònoma de Barcelona
Uni Cantabria
Vista Silicon

Project leaders:

Philippe Garcin
STMicroelectronics

Kees van Berkel
Ericsson

Key project dates:

Start: January 2010
End: April 2013

Countries involved:

France
The Netherlands
Spain

PROJECT CONTRIBUTES TO

Communication	✓
Automotive and transport	✓
Health and aging society	
Safety and security	
Energy efficiency	✓
Digital lifestyle	✓
Design technology	✓
Sensors and actuators	
Process development	
Manufacturing science	
More than Moore	
More Moore	✓
Technology node	

time-to-market in these fields through its new methodology for rapidly assembling various product classes (including mobile phones and automotive) at different cost levels.

Integrating a hierarchy of computing resources with a set of embedded software and run-time functions was successfully performed by COBRA's project partners (thanks to their expertise in hardware, software and automation) who were able to implement hardware and software project elements efficiently and effectively.

Many partners – if not all – provided improvements to performance, through various techniques, such as optimising compilers (for execution speed) and memory bandwidth. And all COBRA partners were strong in design. Some of them offered innovative design techniques for parallel computing (technology push); others were familiar with the circuit constraints to be met in order to be attractive to the market (application pull).

Evolutionary high-performance platform

The soundness of COBRA architecture was fully proven, thanks to its one-die demonstrator fully functional on silicon. Power management was more advanced in COBRA than in competitor platforms, and its communication performance is comparable to its main competitors' offerings. Importantly, COBRA's development work was based on standards – some computing-oriented (such as OpenMP and OpenCL) and others application-oriented (like OpenCV and OpenLANp) – thus ensuring easy interoperability and IP-reuse.

Sharing project knowledge and experience worked well. There were more than 100 publications and conference presentations, and 10 new courses on offer are based on the work and achievements of COBRA. Six patent applications were also submitted.

Good market and business prospects

The global market for video analytics solutions is expected to pass the two billion dollar mark during 2014-2015. The forecast is that the smartphone market will evolve from US$ 481m in 2011 to US$ 927m in 2015, representing a CAGR of 18%. And the market in automotive electronic systems should reach US$ 249 billion in 2015, representing a yearly increase of 9.4% from 2010 to 2015.

COBRA is expected to contribute significantly to the potential of its partners to compete in worldwide markets, and it will secure the competitive power of several European industry sectors, such as telecommunications, TV, multimedia and high-performance computing. Architects and designers (hardware and software) at several project partners are already making direct use of project results.

Finally, there is the question of employment and other opportunities. COBRA will create jobs for small and medium-sized enterprises (SMEs) by providing access to high-technology achievements of larger companies. It will also help underpin the next generation of internal product-development for participating SMEs. Furthermore, this project will safeguard highly qualified jobs in the European nanoelectronics industry, including research centres. These jobs are expected to be inherently more sustainable in the face of Chinese and other Asian competition, thanks to the advanced technology and intellectual property at the core of products developed from COBRA's achievements. And by significantly increasing the degree of innovation present in future products, COBRA will in turn increase the size and utility of product portfolios of industrial partners, and thus help preserve and create jobs.

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