Project profile

CATRENE
Cluster for Application and Technology Research in Europe on NanoElectronics

CA112 | Flexible heterogeneous architecture targets future highly demanding applications [HARP]

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	

Partners:

STMicroelectronics
AIRBUS GROUP INNOVATIONS
SAPEC
CEA
Universitat Autònoma de Barcelona
University of Cantabria

Project leader:

Philippe Garcin
STMicroelectronics

Key project dates:

Start: January 1st, 2013
End: June 30th, 2016

Countries involved:

France
Spain

The HARP project will develop a customisable, heterogeneous design platform for application areas which range from aeronautics to video. Not only will such a unified hardware/software architecture improve design productivity, but its data-flow programming models and reconfigurable memory hierarchy will also facilitate designing future high-throughput, fault-tolerant systems.

Current mobility trends demand huge computational capabilities to process video, speech, healthcare, vehicle and environmental data. Mobility also needs electronic equipment to be very reliable, but also reduce inherent risks. This calls for high-performance design platforms to develop and run high-throughput, fault-tolerant applications.

Radical design for flexibility

HARP aims at achieving the best of both worlds: software (SW) solutions offering flexibility and easy post-production customisation; and hardware (HW) solutions providing high performance and a smaller footprint (hence lower costs). To achieve this, HARP will develop a heterogeneous architecture by integrating in the same system on chip (SoC), an array of processors and hardware intellectual properties (IPs). These IPs – licenced reusable bits of logic or chip-layout design – will be developed by automatic design-flow using high-level synthesis tools, and a data-flow programming model based on data-flow graphic descriptions.

The project's flexible design solutions will target a market segment serviced by global chip suppliers, Intel and AMD, dealing with multi-core solutions and specific graphical processors. Next platform generation, built around ARM Cortex multi-core solutions, will also benefit by easing and accelerating the implementation of ever-evolving algorithms. This will allow faster positioning in target markets: multimedia, image analysis, and mobility support. Products integrating these results will then be proposed much earlier while guaranteeing a good match with an evolving market demand. This will be – in particular – the case of new solutions envisioned for intelligent cameras, where the environment in which the subject moves is analysed and processed to provide augmented reality in support of mobility.

At the hardware level, HARP will extend the existing multi-processor architectures by introducing distributed multi-processing for fabric/cluster control. The HARP-based IP will be handled as an accelerator, and thus invoked from a host processor running the operating system (OS). HARP will also offer a complete programming environment: an array of general-purpose and specialised processors, together with hardware IPs. To facilitate the development of applications, HARP will specify and implement an appropriate HW/SW co-design-flow.

This project will also deliver a toolset comprising component-based models (ACS), static and dynamic compilers (LLVM) and support for programming models for code generation. It will also provide a set of HW/SW co-design environments, including a fast-simulation platform (QEMU) and efficient OS support for all the platforms. Finally, HARP will provide demonstrators to validate applications in aeronautics and video.

Maintaining Europe's competitive edge

HARP, which has a project team representing the European electronics industry and academia, secures the competitive power in several European industries. It does this by allowing European companies remain ahead of the competition by extending their portfolios of innovative solutions. New encoding algorithms could also be used in many-core SoC implementations, thus allowing European businesses to secure their reputation in MPEG video technology.

HARP's HW-SW co-design methodology can be extended to deal with the movement of massive amounts of video-related data across the computing fabric. HARP will also focus on performance-estimation techniques for mapping video applications onto heterogeneous platforms, and on hardware IPs that increase the average performance of video applications.

Of course, consumers will also benefit from products available at a lower cost, and with increased video quality compared to the current H264-AVC standard. There are also plans to double the ratio of data compression (with a resolution of up to 7680 x 4320 pixels).

Aeronautics is another target, where the high-level of redundant electronics equipment, a key safety requirement, represents up to two-thirds of the electronics cost within a commercial aircraft. HARP's fault-tolerant computer architecture based on advanced arrays of multiprocessors will reduce this cost and provide European suppliers of aeronautic systems with a competitive edge (see market details below).

Financial, economic and social impact

The business in which HARP will play a role looks promising. With device-to-device communications (where HARP's deliverables could be deployed) becoming widespread, GSMA (the mobile industry's trade association) forecasts 50 billion devices connected by the end of 2015.

Thanks to HARP, companies could also increase their share of the video market and help European electronics firms maintain their leadership position in set-top boxes (STBs). It does this by ensuring they are among the first (and ahead of the competition) to provide multi-standard video-codecs within the new, high-performance, highly efficient SoC generation, offering UHD5 (a version of ultra-high definition television) support and a quick time-to-market. Furthermore, future video applications will create new business. The worldwide revenue for STBs is expected to exceed US$ 4 billion annually in 2016. With about 8% market share, a leading European electronics concern and project partner, predicts revenue of US$ 1 billion and a 5% growth per year in STB unit shipments. And thanks to HARP-developed technology, revenue, gross margins and market share will grow.

The worldwide market for HDTV H264 video encoders is around US$ 180m with an expected CAGR of 6-7% in the next five years. New algorithms that reduce the bandwidth, and new TV systems like UHDTV and 3DTV, will drive this CAGR growth. And the 65% market share for Intel-based, video-analysis systems is projected to decline and huge gains are expected in the digital signal processing (DSP) market in 2014-2016.

In aeronautics, the world's passenger aircraft fleet (above 100 seats) will grow from 18,500 aircraft to 37,500 by 2033. At the same time, some 10,500 aircraft from existing fleets will be replaced by more eco-efficient models. Importantly, HARP's fault-tolerant system could be marketed by aircraft suppliers as a unique selling point, based on its benefits.

HARP will also significantly contribute to project partners' potential to compete in the worldwide markets and, thus drive employment. This means it will not only safeguard high-qualification jobs in European microelectronic industry, but it will also generate new jobs at small and medium-size enterprises (SMEs) and create opportunities by sharing the project's high-tech results.

Having three of the project partners involved in European education will provide effective channels to generate, accumulate and disseminate key technical knowledge to the wider education community and beyond.

HARP will also have an impact in another important area. Computing power is strongly correlated to energy consumption, and mobile equipment has limited access to permanent power sources. Energy efficiency is therefore a main part of HARP's requirements, and elements, such as embedded multi-core processors, will be key enablers in sustainable and energy-efficient projects.

In short: HARP will provide lucrative video and aeronautics markets with key technologies and substantially increased computing power and reliability, while keeping costs and energy consumption low, and employment high.

CATRENE
Cluster for Application and Technology Research in Europe on NanoElectronics

CATRENE Office
9 Avenue René Coty - F-75014 Paris - France
T. +33 1 40 64 45 60
E. catrene@catrene.org
www.catrene.org

CATRENE (Σ! 4140), the EUREKA **C**luster for **A**pplication and **T**echnology **R**esearch in **E**urope on **N**ano**E**lectronics, will bring about technological leadership for a competitive European information and communications technology industry.

CATRENE focuses on delivering nano-/microelectronic solutions that respond to the needs of society at large, improving the economic prosperity of Europe and reinforcing the ability of its industry to be at the forefront of the global competition.