2PARMA

PARallel PAradigms and Run-time MAnagement techniques for Many-core Architectures

HiPEAC Innovation Event,
May 3-5, Edinburgh, UK

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FP7-248716-2PARMA Project
2PARMA-List of Partners

1. Politecnico di Milano (POLIMI) – Italy (Coordinator)
2. STMicroelectronics SRL (STM) – Italy
3. Fraunhofer Institut for Telecomm. / Heinrich-Hertz Institut (HHI) – Germany
4. Interuniversitair Micro-Electronica Centrum (IMEC) – Belgium
5. Institute of Communication and Computer Systems (ICCS) - Greece
6. RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN (RWTH) - Germany

CoWare - Belgium

Project Coordinator
prof. Cristina SILVANO, POLIMI

Project Technical Manager
prof. William Fornaciari, POLIMI

Project Officer
Zulema OLIVAN-TOMAS

Start date: January 1st, 2010
Project duration: 3 years
Total effort: 408 PM
EC Contribution: 2.74 M€

www.2parma.eu
Back-ground & side-ground projects

- PRO3D
- Artemis - SMECY
- HiPEAC2

FP7-248716-2PARMA Project
The 2PARMA project focuses on the definition of suitable parallel programming models, instruction set virtualisation, run-time energy/power and resource management policies and mechanisms as well as design space exploration methodologies for Many-core Computing Fabrics.
The 2PARMA project focuses on the flexible family of parallel and scalable computing processors, which we call **Many-core Computing Fabric Template**, composed of many homogeneous processing cores interconnected by an on-chip mesh.
Platform 2012: Architecture Template

Source: STMicroelectronics
IMEC Many-core computing architecture based on ADRES processor
Target Applications and Architecture Integration

• Scalable Video Coding (SVC) - HHI
• Cognitive Radio
  – Physical Layer – RWTH-ISS
  – MAC Layer – RWTH-MOBNET
  – Reconfigurable Radio – IMEC
• Multi-view Image Processing - IMEC
Project Promises

1. Increased performance, power-efficiency and reliability of homogeneous Many-core Computing Fabrics, by means of:
   - Fine grained platform configuration
   - Dynamic resource management techniques

2. Improved time to market for high-performance applications requiring hardware acceleration by means of:
   - ISA virtualisation on computing fabrics
   - Supporting the full tool/design chain, including compilation and OS support

3. Reinforced European scientific and technological leadership in the multi-core computing architectures both at:
   - Industry side (STM as a large company and COWARE as a SME)
   - Academic side (POLIMI, HHI, IMEC, ICCS and RWTH)

4. The project will contribute to Free and Open Source projects:
   - ILDJIT dynamic compiler
   - MULTICUBE Explorer framework
   - Run-Time resource managers seats on top of Linux OS

5. The project will also spearhead the evolution of standards in the field of parallel programming models and languages (such as OpenCL)
The basic idea behind the 2PARMA project is to combine the automatic extraction of parallelism to dynamic compilation in order to exploit the management of system resources at runtime.
2PARMA Expected Impact

**Exploit**
- Research
  - OMP, MULTICUBE, MOSART, NUCLEUS
- Standards
  - Linux, OpenMAX, OpenCL, ECMA-335, SVC, SDR
- Platform/R&D
  - STM Platform 2012, IMEC virtual platform
- Applications
- Reference Platforms

**Produce**
- ILD/JIT dynamic compiler
- Nucleus CBE toolchain
- DSE toolchain
- Run-Time manager
  - CoWare prototype toolchain
  - OpenMAX, OpenCL extensions
  - SVC, multiview, Cognitive radio
  - STM Platform 2012 ADRES-based virtual architecture

**Further research:**
- Dynamic parallelization
- Integration of Hz and Sw run-time management

**Commercialization and Beta testing**
- CoWare commercial toolchain
- Next user platform developing & porting
- OEM reference implementations

**Industry rollout**

**Future Research for ESOL tools**

**Product rollout**
- Commercial many-core based devices

**Future Research roadmaps**

**IMPACT**
- 2PARMA Duration 3 Ys (STREP)
- Dissemination & Commercial Exploitation of 2PARMA research
- Next User Impact (SW vendors, OEM)
- End User Impact

2010  2011  2012  2013  2014  2015 & beyond
Beyond 2PARMA
Research and Technical issues to be addressed in Computing Systems

1. Computing Architectures
   - Many-core with enhanced energy management
   - Platform configurability at different granularities
   - Resource management techniques statically and at runtime

2. EDA & Methodologies
   - Multi-objective optimization, design effort/time modeling
   - Open source benchmark suite of applications (with industrial constraints)

3. Compilation and Software architectures
   - Static and dynamic compilers, ISA virtualisation
   - Parallel programming models and languages
   - Energy aware optimization and design of software and operating systems

4. System/platform software, hw/sw interface
   - Operating system support for scheduling and allocation of Threads/Processes
   - Run-Time resource management for power/resource/reliability (hw and sw managers)
Info and Contacts

- **2PARMA web site**
  - [www.2parma.eu](http://www.2parma.eu)

- mailing list

- **Project Coordinator**
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- **Project Tech. Manager**
  - prof. William FORNACIARI
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Backup slides
WP2: Programmability of Parallel Computing Systems

Task 2.1 High-level programmability of parallel hardware

Task 2.2 Virtualisation and dynamic compilation

Task 2.3 Operating System Integration
WP3: Co-exploration of Architectural Platform(s) and Programming Models

Task 3.1 Profiling methodology for parallel computing platform

Task 3.2 Efficiency analysis of parallel programming models

Task 3.3 Design Space Exploration for supporting run-time system management