Open-PEOPLE: Open - Power and Energy Optimization Platform and Estimator

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***Abstract*—This paper presents the Open-PEOPLE project that intends to provide a platform dedicated to power and energy measurement, estimation and optimization for complete embedded systems. Such systems include complex hardware components (FPGA, DSP, GPP, SoC, MPSoC, Memory...), an operating system (real time or not) and embedded applications. The project is open to the designers and developers community through a software platform made of a web portal and a standalone application gathering power and energy estimation tools, and a library of power models. The web portal is coupled to the hardware platform which is dedicated to power measurements on real boards in order to enrich the models library. Objectives of this project include the development of methods to perform power consumption characterisation of complete embedded systems. It aims to provide a set of tools to analyse and optimize power consumption at different levels of abstraction during the design process.**

I. Introduction

Designing low power complex electronic devices is now a key challenge for corporations in a large number of electronic domains. The motivations, which lead designers to consider low power designs, are multiple: to increase lifetime, to increase autonomy, to limit battery capacity, limit temperature.... Unfortunately, there is currently neither methodology nor tool to obtain an accurate estimation of consumption for a complete system at different levels of description, i.e. at different design steps.

The Open-PEOPLE project aims at providing a complete platform i) to allow rapid power/energy estimation for complex systems, ii) to test different optimizations in order to significantly reduce its power consumption. The goal of the Open-PEOPLE platform is also to provide an access to an automated power and energy measurements bench, including different boards (GPP, DSP, FPGA...)and to control power estimations and optimizations tools.

II. Open PEOPLE Platform: Main aspects

The platform developed within the frame of the Open-PEOPLE project is made of two parts as described in Figure 1. The first one is dedicated to the Power Consumption Model Development (PCMD). It is based on automated framework to build power consumption from measurement campaigns on real boards that can be remotely controlled through a web portal.

The second part is devoted to Power Consumption Analysis and Optimization (PCAO). It makes use of the power estimation models developed previously and is composed of MDE based estimation tool (CAT: Consumption Analysis Toolbox [3]). As shown in Figure 1 the Open-PEOPLE platform can

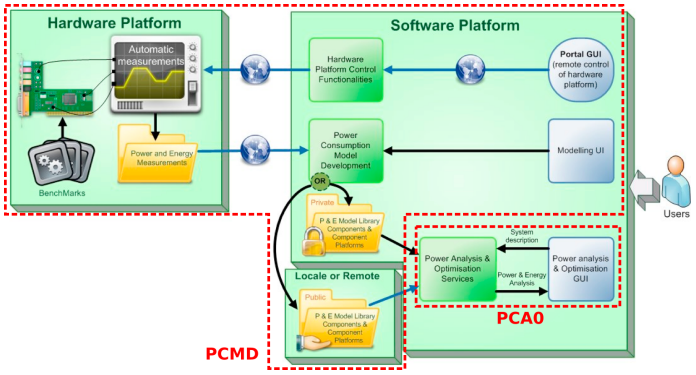

Fig. 1. The Open-PEOPLE project platform

also be decomposed into a hardware platform and a software one. Both are detailed in the following sections.

III. OPHWP: Open-PEOPLE Hardware Platform

The hardware platform allows to perform power consumption measurements on embedded systems widely used in industry. The targeted boards include the following components:

- General Purpose Processor: ARM926, ARM Cortex-A8, ARM Cortex M0, ARM Cortex M3, PowerPC 405, PowerQuicc2, ...
- Digital Signal Processor: TMS320 C64x, TMS320 C67, Blackfin ADSP-BF537, ...
- Homogneous Multi cores: QorlQ P2020 (2x e500(v2) cores) QorlQ P4080 (8x e500mc cores), TMS320C6474 (3 DSP cores), ADSP-2146x, ...
- Heterogeneous Multi cores: OMAP-L138, OMAP 3525/30, TMS320DM5467
- FPGA: Spartan6, IGLOO, ECP3, Virtex 2 Pro, Virtex 5FX, Virtex 6, Stratix 3, Stratix 4,
- Memories: CY62167, SDR, mSDR, mDDR1, DDR2, mDDR2, DDR3, NOR Flash, SLC NAND, MLC NAND
- Buses: I^2C, SPI, Ethernet 10/100/1000, PCI Express, UART, PCI, CAN
- Interfaces:Video Sensor, ADC/DAC, Bluetooth, GPS, Batteries, Wi-Fi, GSM, 3G/GPRS

As shown in Figure 2 the platform is also composed of several power measuring instruments in a dedicated private network. The power analyzer provides power supplies to the devices and accurately measures the static consumption. The high speed multimeter operates at high frequency to allow measurement of the CPU core peak power. A precision multimeter is used to measure small currents and a multiplexer allows to measure several points on several devices with a single multimeter.

Devices configuration and power consumption measurements are automated thanks to a sophisticated benchmark server. This is accessible through web services called by the Software Platform described in the following section.

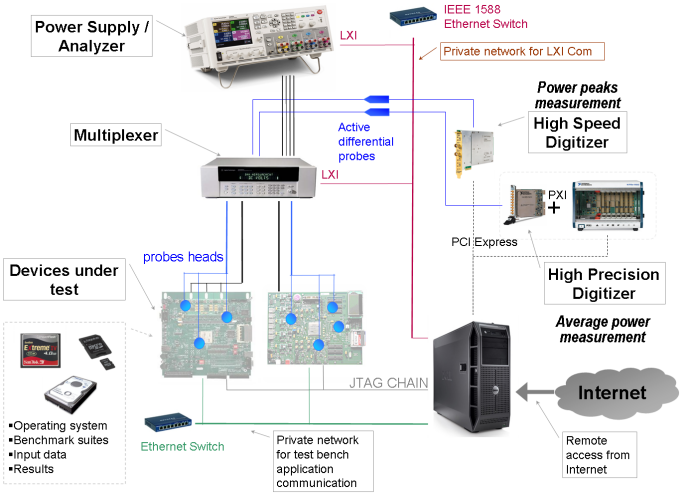

Fig. 2. The hardware platform of the Open PEOPLE project

IV. OPSWP: Open-People Software Platform

The software platform provides several services to the users.

A. Remote Control: An access to the OPHWP platform

First, through a web portal, it gives access to the OPHWP to run experiments allowing to build new consumption models and/or to check/verify that the deployed application respects power consumption or energy constraints. The web portal is therefore in charge of transferring applications and optionally the operating system to the hardware platform. Timing and power consumption results are returned and used to build consumption models. The system supports concurrent access to the hardware devices thanks to a scheduling strategy on the benchmark server. Finally, the confidentiality is ensured through highly secured protocols and user's identification across the entire platform.

B. Speeding up the design time by providing power consumption estimations at higher levels of abstraction

As described previously, the OPHWP platform allows to develop power consumption models. These models can then be used to perform power consumption estimation at a higher levels of abstraction in a MDE design flow. Indeed, the OPSWP embeds CAT that was developed in the frame of the European ITEA-SPICES project [2]. CAT is integrated with the Architecture Analysis and Design Language (AADL [1]) to provide power consumption analysis at the early stages of the design phases. The tool is extensible and models for new components can easily be integrated thanks to a new standard defined within the project that associates in the same description the modeling of components and their power consumption. The OPSWP relies on the Eclipse Integrated Development Environment platform and other Eclipse based tools can be developed to enlarge the scope of this work.

V. On going and future work

As described before, a major aspect of this project is its "openness", meaning that hardware platform, methodologies and tools are available to the community. This is accomplished thanks to a web portal available at:
https://www.open-people.fr.

This project has also the advantage to be extensible through a set of available tools aiming at building new power consumption models. Therefore adding future component models is possible. The Open-PEOPLE partners are currently developing power consumption models for the OMAP 3530 and Virtex 5, Spartan 6, ARM and PowerPC platforms). Future work includes the development of new methodologies to analyse and optimize power consumption.

Acknowledgment

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