Kaolin, a model-based EDA tool to program, reuse or retarget embedded systems on FPGAs.

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Abstract — **The demonstration presents the Kaolin EDA tool to improve and speed-up embedded systems development on FPGAs. It provides modeling abstractions to shield the user from implementation details and prevent recurrent time-consuming errors. It allows user to reuse legacy projects and IPs and retarget them to other platforms with different back-end tools. The Kaolin technology is based on models of components, platforms and FPGA development tools. It allows automating platform-independent system generation, verification and high-level analysis, and template-based documentation generation. Kaolin promotes user appropriation. It fits in the development flow as a bridge between the user and low level FPGA vendor tools.**

Keywords — FPGA; Embedded systems; EDA tools; Model-Based Engineering; AADL.

I.   CONTEXT

Competition in the market for embedded systems is severe and highly demanding. It requires continuous product improvements with tight product development schedules to respond to time-to-market. The need for increased investments rapidly becomes one of the most competitive issues. To maintain the technological advances, companies have to be reactive to against the rise of application complexity and constraints such as performance, power consumption or cost. In that context, the choice of the underlying technology is decisive.

FPGA is a solution for embedded systems between very expensive ASICs having specific architectures dedicated to a limited number of applications and processors with generic, flexible but less efficient architectures. FPGAs overcome their concurrent in terms of performance, cost and energy when designers can take advantage of available parallelism, custom operations, flexibility and large numbers of I/Os.

However, a lot of companies, especially SME, reject FPGA to the detriment of standard processors. Their main argument is the FPGA development cost. Indeed, creating, verifying, maintaining or retargeting a FPGA system with current vendor tools requires today a high-level of hardware and tool expertises and so mean a risk more significant than FPGA technical profits.

II.   KAOLIN, A MODEL-BASED EDA TOOL

Kaolin tackles the challenge of raising the abstraction level of the design on FPGA. It's an EDA tool designed to practically improve and speed-up embedded systems developments of both expert and new FPGA engineers. With Kaolin, SMEs can complete their software engineering capabilities with FPGA development. Kaolin allows to:

- Automating platform-independent system generation including vendor tool files and scripts. Designers can create or improve existing systems and integrate new components, reuse legacy projects and IPs and retarget them to other platforms with different back-end tools;

- Automated verification. Designers can specify chronograms and test vectors. Kaolin generates simulation tool scripts and testbench files. Embedded verification can also be performed at runtime;

- High-level analysis to obtain upstream decisional data (performance, consumption or area estimations);

- Generate template-based documentation.

The Kaolin technology is based on models of components, platforms and FPGA development tools. It shields users from implementation details, prevents common time-consuming error. Users can thus concentrate their efforts on value added production.

III.   A USER-ORIENTED TOOL

Kaolin is designed to fit in the development flow as a bridge between users and low-level FPGA vendor tools. User appropriation is facilitated:

- Kaolin requires no new language to be learnt. With component diagrams, users specify the functional and platform-independent aspects of their system. They aggregate IPs from components library and interconnect them with signals, FIFO, shared memories and bus with protocols. They parameterize platform and low-level toolchain. Kaolin provides also textual mode with a fully synchronized Diagram to textual features.

- Kaolin promotes experiences capitalization. It allows the user to feed the libraries with existing and new codes. The user can thus import legacy codes (HDL) and also migrate software (C/C++ for HLS or DSP) to hardware code with built-in High-Level Synthesis capabilities. He can finally develop new component from HDL, C/C++, FSM…

- User interface is highly flexible and can be customized to meet domain and user-specific requirements.

IV. DEMONSTRATION

During the demonstration, Kaolin will be used to quickly implement a control and signal processing system deployed on a FPGA and embedded on a toy car controlled by a smartphone.