

Synopsys and KYOCERA Document Solutions

KYOCERA Designs High Performance Image Processing DSP for Next Generation Multi-Function Printer Using Synopsys Processor Designer



Synopsys' reputation as an established provider of ASIP development tools, along with their multi-function printer design wins worldwide were key factors in our decision to use Processor Designer for the design of our optimized image processing DSP."



Michihiro Okada

General Manager of the Software 3 R&D Division, Corporate Software Development Division at KYOCERA Document Solutions Inc.

Business

[KYOCERA Document Solutions](#) is a leading manufacturer of document imaging solutions and document management systems, including color and monochrome multi-functional products and printers and wide format devices. KYOCERA Document Solutions Inc. is a core company of KYOCERA Corporation, the world's leading developer and manufacturer of advanced ceramics and associated products, including telecommunications equipment, semiconductor packages and electronic components.

KYOCERA's products are renowned for their unique long-life imaging components that provide greater reliability, less waste - resulting in a lower Total Cost of Ownership (TCO) over the life of the product. The KYOCERA Document Solutions portfolio does not stop at hardware. A full suite of business applications and consultative services allow customers to optimize and manage their document workflow, unleashing the full potential of their hardware investment.

Challenges

- ▶ For each multi-functional printer model, image processing algorithms, performance requirements and functionality vary, traditionally requiring the development of model-specific fixed hardware ASICs

- ▶ Fixed hardware lacks programmability and flexibility, which requires an ASIC re-spin when functionality is modified or bugs have to be resolved
- ▶ General purpose DSPs do not meet image processing performance requirements
- ▶ SoC solutions combining general purpose processors, fixed hardware and general purpose DSPs do not meet power consumption requirements

Synopsys Solution

- ▶ Processor Designer, application-specific instruction-set processor (ASIP) design and optimization tool

Benefits

- ▶ Reduced overall SoC development time and cost
- ▶ Efficient DSP architecture exploration using a top-down design flow, enabled by the automatic software tool generation from a single processor description
- ▶ C compiler development within a few months, using Processor Designer's compiler generation flow
- ▶ No royalty costs

Overview

KYOCERA launched a corporate initiative to develop total document solutions setting a new efficiency standard. For this, KYOCERA required a flexible, yet high performance SoC design at the heart of

their next generation multi-function printer, offering optimal power and performance combined with full programmability. KYOCERA analyzed standard DSP solutions, and quickly decided that none of them were achieving the design objectives. KYOCERA decided to build a custom DSP tailored to their specific requirements, making it an application-specific processor (ASIP). KYOCERA had a tight deadline to complete the project, and the tasks involved with designing an ASIP:

- ▶ Development of software development tools, including simulator, assembler, linker and debugger
- ▶ Efficient C compiler development
- ▶ Efficient exploration of DSP architecture alternatives

Completing these tasks in time was impossible using a manual approach. KYOCERA concluded that it needed a tool-assisted ASIP solution and turned to Synopsys.

ASIP Design Calls for Flexible Design Tools

Image processors are customized in every facet, from their unique algorithms to their performance and power requirements. KYOCERA knew that an existing DSP would not deliver the required performance and power efficiency, and fixed hardware would not give them the required flexibility. Therefore an application specific processor (ASIP) became the ideal solution.

Processor Designer accelerates the design and verification of ASIPs, enabling a top-down design flow. Using a single input specification, elements like instruction-set simulator (ISS), software tools (assembler, linker, debugger and C compiler) and RTL implementation model are generated automatically.

The early availability of a simulator enabled KYOCERA to perform architecture exploration of their DSP, measuring the impact of different architecture

alternatives. Architectural alternatives are quickly captured in the input specification as a single source, which allowed KYOCERA to focus on the architecture goals, with the simulator and software tool chain updated automatically.

KYOCERA established a software development environment early in the design phase, enabling significantly earlier software development through the generated ISS. Starting software development earlier helped KYOCERA locate hardware and software bugs early in the design phase, thus avoiding an ASIC re-spin late in the design.

A key element of any DSP design is the development of a C compiler. Processor Designer's C compiler generation capabilities enabled KYOCERA to develop a C compiler within three months.

Finding the Perfect Balance

Using Processor Designer KYOCERA found the perfect balance of performance, power and gate count to meet their image processor performance goal.

KYOCERA completed their highly tuned DSP design within one year, including architecture exploration, software tool development, RTL design and application software implementation.

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"Synopsys' Processor Designer tool gave us the entire range of capabilities we needed to design our custom DSP and allowed us to focus on our architecture goals and not worry about software tool chain development."

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