How to implement a digital oscilloscope in Structured ASIC fabric

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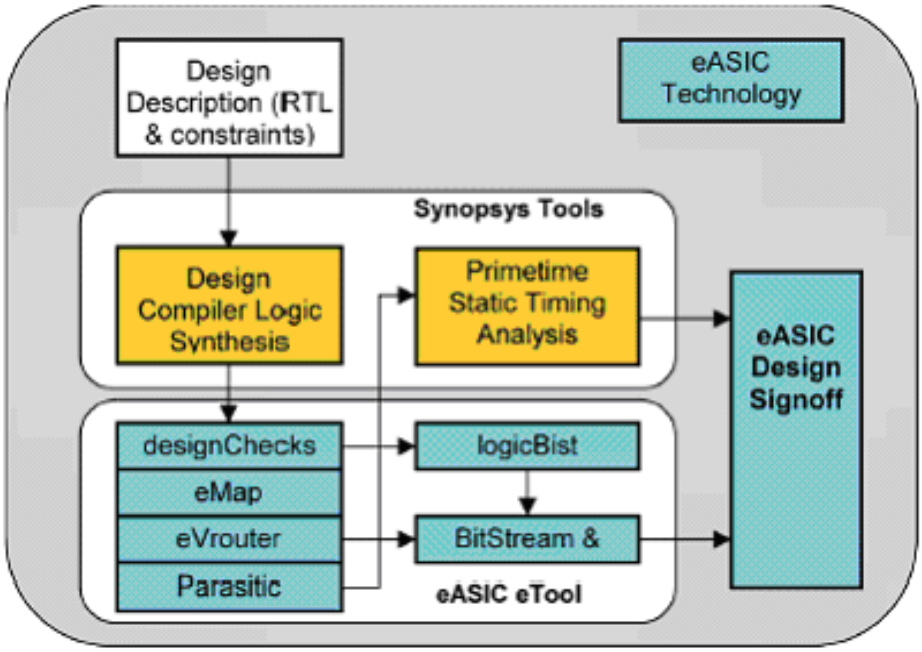
Implementing the eScope on eASIC"s Programmable ASIC fabric

The eTool design flow used for this implementation is illustrated in Fig 9 and is based on ASIC design tools for a standard cell design. This tool flow leverages existing ASIC design methodology and infrastructure as much as possible.



9. The eTool design flow.

Logic synthesis was performed with the Synopsys Design Compiler synthesis tool using eASIC"s Liberty-format synthesis library containing all of the two, three, four, and five input functions that can be implemented with combinations of LUT configurations in the eCell, as well as the inverting buffer models and a number of DesignWare components that have been optimally implemented in the eCell logic.

The netlist produced by Design Compiler is passed through the eASIC-developed "technology mapping and packing" tool (called eMap) that replaces the slower LUT-based functions with faster nand and mux functions where possible, and then packs multiple functions into a single eCell where possible. The netlist created by eMap was characterized with standard wire-load models before place and route for use with the Synopsys Primetime static timing analysis.

The results from the implementation of eScope on eASIC"s Structured ASIC fabric using the Synopsys tools as described above are reflected in Fig 10.

Clocks	Synthesis (ns)	Mapping (ns)	Place & Route (ns)
system	3.95	4.72	7.53
wave generator	3.00	4.43	5.42
host interface	26.37	28.97	35.62

Synthesis (eCells)	Mapping (eCells)	Place & Route (eCells)
5945	3923	3923

10. eScope implementation timing and area results.

The back-end design flow uses eASIC"s eMap and eVrouter tools to implement the final place and route. Parasitic extraction was performed to annotate the final netlist for back-end (signoff) static timing analysis using Primetime. In parallel, logicBIST (embedded BIST) test parameters are created and embedded into the final bitstream and Via Mask database. The bitstream assembly and the configuration via mask generation steps are performed using the eDK tools.

The graphical user interface (GUI)

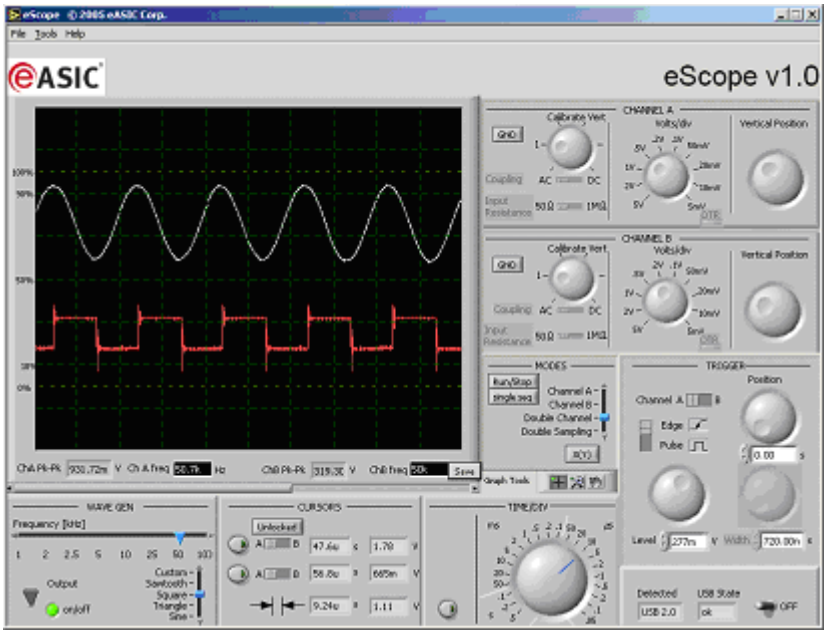
eScopeSW is a GUI application that controls the eScope hardware. It was developed as a LabVIEW "VI" using the LABVIEW development environment and C libraries. The USB interface is the physical medium used for data transfer between the eScope hardware and the PC running the eScope software. The communication between GUI and eScope device uses a 2-layer structure as follows:

- *EZ-USB driver (written only for the Win32 platform).*
- *C high-level access functions that access the low-level driver"s functions.*
- *The EZ-USB driver is responsible for data transfer between the software and the hardware modules. It provides low level functions that are used in the C libraries.*

There are two kinds of C function:

- *Low level functions (read/write samples/register values, connection status) that use the features implemented in the EZ-USB driver.*
- *High level functions that the driver. These functions are called by the LabVIEW application when an operation accessing the hardware module is done.*

A screen shot of the eScope GUI application is shown in Fig 11.



11. The eScope GUI application.

Graphical objects include controls and indicators. The controls are divided into Boolean controls (push-buttons), toggle buttons, horizontal switches and numerical controls: horizontal and vertical sliders with multiple values. The indicators are divided into numerical, text indicators, leds, and graphical waveform indicators. The controls and the indicators from the front panel are grouped by function as might be found on a traditional desktop oscilloscope.

Summary

eScope was developed as a reference design to be used in a tutorial for the eASIC design tool flow and to demonstrated the technology advantages of eASIC"s innovative Programmable ASIC fabric for high-speed logic design. In addition, eScope demonstrates that high-speed, low-cost products can be created using programmable-ASIC technology from eASIC Corp.

References

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