System Emulation and Rapid

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Several third-party products now use Xilinx FPGAs to provide you with system emulation and rapid-prototyping tools that help you get your designs up and running as quickly as possible. The same features that make Xilinx FPGAs excellent ASIC replacements also make them excellent emulation devices.

Because Xilinx FPGAs offer internal performance of over 100MHz, these third-party emulators can run at system speeds when efficient EDA tools and verification flows are used to create the emulation netlist. In addition, the ability to reprogram during system debugging is a key feature

System, and system-on-a-chip (SOC), ASIC emulation with Xilinx FPGAs provides you with three distinct advantages:

- **Speed** - In a matter of hours, with an emulation engine, you can exercise more product functions than are possible in days or weeks of simulation.
- **Rapid prototyping -** With the automated emulation software and ready made emulation hardware, system prototypes involving ASICs, FPGAs, standard parts, and microprocessors can be produced very quickly. Development and debugging of the prototypes is much easier and faster with an emulation system than with a home-grown breadboard.
- **Promotes hardware/software co-design** - Real software can be run on the emulated system, so hardware and software interface issues are caught early. Overall system development time is greatly reduced because costly re-work cycles are shortened in an emulated system that can be reprogrammed rather than remanufactured.

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The Advantages of Xilinx High-density FPGAs

System designers, or their team members in verification, can emulate vast sections or even whole systems-on-a-chip (SOC) using high capacity, high-performance Xilinx FPGAs. "In a system prototyping environment, the large capacity, high pin count FPGAs, such as the Xilinx XC4000XV family, greatly simplify the process of building system prototypes with large ASICs. Our customers are able to preserve the hierarchy of their design by mapping large design blocks into individual FPGAs for prototyping. Consequently design debugging becomes much more intuitive," stated Michel Courtoy, Director of Product Marketing at Aptix Corporation.

Whether a Xilinx FPGA, an ASIC, or both are used in your system design, emulation can be a critical tool for system verification because simulation speed becomes a major barrier to on-time delivery as the complexity of chips and systems increase. The functional simulation and verification of high-density HDL is a major portion of the system design schedule. Design verification and the resulting timing and functional closure of the design will often be two to four times greater than the design entry time.

Running a significant number of well-constructed vectors, in a timely manner, is crucial to catching the maximum number of bugs in the shortest time. The earlier in the design and implementation cycle the functional errors are caught and corrected the greater the savings of time and effort. Emulators can run greater than 10^6 times faster than workstation simulators. The thoroughness of the verification is especially true if several components of the system can be simulated together. And, if more of those components can be placed on the same high-density Xilinx FPGA, you need to do less partitioning and therefore the emulation can be created that much sooner. The high-density parts from Xilinx with capacities of

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Prototyping Using Xilinx FPGAs

100K to one million gates can aid in the retention of design hierarchy and in reducing the partitioning overhead.

High-End Emulation Systems

There are a number of fine methodologies and tools for emulation and rapid-prototyping that use Xilinx FPGAs to their advantage. FPGA-based emulation is recognized as the most flexible hardware emulation technology. It provides the highest in-circuit emulation speeds and supports all design styles from fully synchronous to fully asynchronous. The Aptix System Explorer series and the Quickturn System Realizer are two high-end emulation products using Xilinx FPGAs for emulation.

This technology as expressed in Quickturn's System Realizer product can support designs from 100k to three million gates. HDL code is compiled, partitioned into blocks, and mapped into the logic elements of the Xilinx FPGAs within the System Realizer. The product can support IP as soft cores in either HDL or netlist forms, including vendor encryption if necessary. Or the core can be bonded out in the Component Adapter Card in the Programmable Target Interface Module (PTIM) which is a standard part of System Realizer.

Once the design is in the system, powerful debugging tools can be brought into play as a large number of vectors are processed at speeds several orders of magnitude higher than simulators. The Vector Debug mode reads vector data off of your workstation disk and applies it to the circuit in the emulator. The Regression Test mode provides automatic vector comparison for quick-go/no-go testing. 128K of vectors can be run at speeds up to 1MHz in an IC-tester-like validation environment. Add-in cards can increase the vector capacity. The In-Circuit Emulation mode is the most powerful and comprehensive way to verify complex systems. The emulation hardware becomes part of the system hardware prototype that runs real data and software.

The Aptix solution offers an open architecture approach. The Aptix System Explorer MP3A and MP4 products are based on Field Programmable Interconnect Components (FPIC) and Field Programmable Circuit Boards (FPCB). The FPCBs allow component insertions directly on the board or through a daughter-board module using the standard hole patterns on the FPCBs. The Aptix Axess software connects your components on the FPCB through the reprogrammable FPIC.

The Aptix emulation systems are very flexible. The programmable interconnect devices, FPGAs, and other devices can be mounted on a board that provides routing paths such that each pin hole on the board connects to a programmable interconnect path. You can also mount them on daughter boards allowing you to mix and match different Xilinx FPGAs and quickly upgrade to the latest versions to obtain the best performance. Other system devices such as RF components or microprocessors can also use this daughter board approach.

Because of this open architecture, multiple projects can use the System Explorer. All popular EDA design tools are supported as well. This system can be used as a "faster simulation" engine or as a hardware prototype allowing real data and software to be run through the emulated hardware system. With flash memory to hold the interconnect paths the emulated systems can be detached from the workstation and you have a rapid-prototype you can put in the real system environment.

These Aptix and Quickturn solutions provide the greatest flexibility for both running simulations and hardware prototyping with a wealth of development and debugging tools and options.

Conclusion

Xilinx FPGAs, with their ever-increasing capacities and speed performance, are crucial to the verification of systems and large ASICs through FPGA-emulation.