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Predictable Success

"Every engineering student should learn to use the Identify tool."

— John Lockwood,
Associate Professor,
Washington University

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Success with the Synopsys® Synplicity® Business Group and the Reconfigurable Network Group

Identify® Success Story

Summary

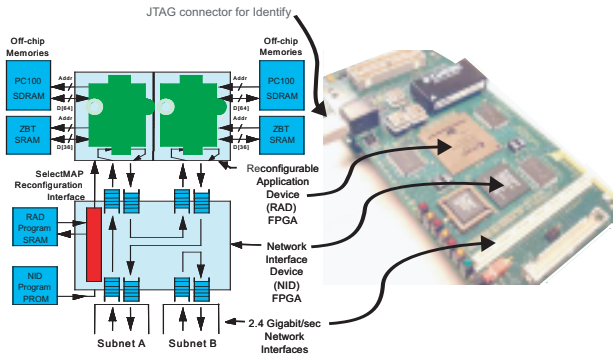
The Reconfigurable Network Group (RNG) at Washington University in St. Louis uses the Identify® FPGA debugging product from Synopsys' Synplicity Business Group extensively in its engineering courses and research projects. Washington University, a long time user of the Synplify Pro® FPGA synthesis tool that is also from Synplicity, has found the Identify tool ideal for debugging complex Internet packet processing systems, its core application area. Using the Identify solution, RNG has been able to pinpoint the sources of problems that would have been virtually impossible to find using any other method.

20% Faster Synthesis Results

The RNG is dedicated to advancing the state of the art in high performance networking through an aggressive research program that blends fundamental and experimental activities. The RNG develops new applications for network-connected systems that employ dynamically reconfigurable hardware, with a special emphasis on Internet security. One of this group's many contributions to making the Internet safer, faster, and more flexible was the development of the Field-programmable Port Extender (FPX), a hardware board containing two Xilinx Virtex 2000E FPGAs along with memory and two multi-gigabit/second network interfaces. The FPX serves as the platform for the group's research projects, many of which have culminated in technologies deployed in network data mining systems.

Since the FPX and its FPGAs are central to its research, the RNG pays particular attention to tools for synthesizing and debugging FPGA programs. In 2000 they standardized on the Synplify Pro product based on extensive experience with FPGA synthesis tools. "We found that Synplify Pro delivered results that ran at least 20% faster than those produced by other products on the market," said Dr. John Lockwood, Associate Professor at Washington University and Principal Investigator of the Reconfigurable Network Group. "We also found it easier to learn and use than any other

Field-programmable Port Extender (FPX):
Multi-Gigabit/second Network Processing Platform



such tool, which is especially important in a university environment where students must be able to learn a tool quickly if they're to have time to use it to contribute on projects."

Debugging Complex Circuits where Simulation and Logic Analyzers Prove Impractical

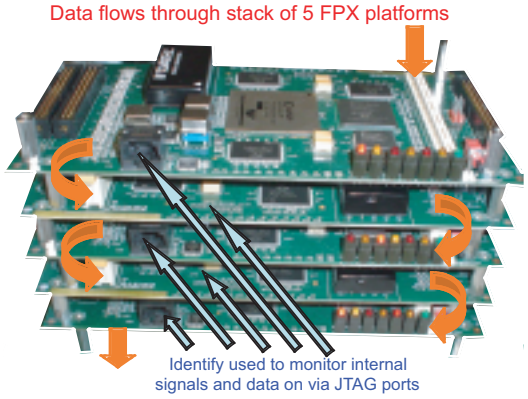
Washington University has been a long time user of Synplicity tools and was therefore one of the first groups to use the Identify tool when it was first released. The product was an immediate hit within the group, which was facing particularly vexing problems verifying the correct operation of complex Internet packet processing circuits. These circuits must respond properly to packets that contain random bit errors, data retransmissions, and traffic with unpredictable delays. Because of the sheer volume of data involved and the length of time between errors, simulation was an impractical way to recreate error conditions. On some of the more complex projects in its plan, the group estimated that it would take years for simulation to find the source of an error. Therefore, as its debugging approach, the group had moved toward analyzing logic in real time on live data, and had acquired a logic analyzer for the purpose. However, they found that as the sophistication of their projects increased, pin limitations on the logic analyzer and the FPGA itself severely constrained the width of data buses that could be monitored.

In the Identify tool, which can operate in real time on live data without degrading a system's performance or altering its behavior, RNG saw the solution to its problem. "In essence, Identify allows us to instantiate a logic analyzer within the logic of an FPGA. We can run the system at full speed and see the traces of signals whenever something doesn't run as expected," said Lockwood. "In source code we can select signals to be highlighted and then monitor them to see what their values are. I found it particularly compelling how well Synplicity does that. Before committing to the product we briefly examined some competitive software tools but found Identify to be far more mature."

RNG found the Identify tool, like the Synplify Pro product before it, very easy to learn and use. "Within days, our students were fully up to speed in using advanced features of the tool," said Lockwood. RNG quickly made the solution a staple in its research projects and also in its courseware, where both graduate and undergraduate students learn to use it in the engineering curriculum.

Pinpointing Bugs in Complex Five-Board, Multi-Application Systems

With the Identify product in its arsenal, RNG is equipped to take on more aggressive projects than ever before. The group's current project is an "Automated Front End" system for decoding the semantic data that appears in a TCP/IP network flow using a stack of five FPX platforms, each running a unique application. Data flows continuously among the five boards, creating an environment that is very complex and difficult to debug. By focusing the Identify tool on the intermediate data passing from one FPGA to another, however, the group has the visibility it needs to debug the system's problems as they arise. "We had one particularly nasty bug that we suspected was



5 FPX platforms with 10 FPGAs stacked to implement complete Automated Front End (AFE) processing system.

due to a buffer overflow between two boards of the system," reported Lockwood. "Using Identify we were able to instrument the hardware to let us see exactly when and where the symptoms occurred, which was precisely the information we needed to rectify the problem."

Lockwood will soon assume a Visiting Associate Professor role at Stanford University, where he plans to use the Identify tool to debug circuits on the NetFPGA, a low-cost networking processing platform designed to empower mass experimentation with FPGA-accelerated networking functions. "Just as at Washington University, I plan to use the Identify tool at Stanford," he concluded. "In fact, I believe that every engineering student should learn to use the tool."

More information about the group is on-line at http://www.arl.wustl.edu/projects/fpx/reconfig.htm.

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