CASE STUDY: SIGPRO

From contract to fully functional diagnostics & RedBoot in one week saves weeks of internal effort and real dollars

BACKGROUND/OVERVIEW

Sigpro LLC (www.sigpro.com) is a Mountain View, California-based firm specializing in "Voice Communication at the edge of the Internet." The company develops embedded systems to help semiconductor providers bring competitive products for interactive voice, advanced technology and edge networking to market.

Sigpro was founded in 1994 to apply a practical, systems-oriented approach to the product development process. Sigpro's staff of technical professionals possess, on average, 20 years of experience in fields such as multimedia network protocols, telephony, wireless communications and embedded control.

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- Mark Dzwonczyk, Sigpro's CEO

THE CHALLENGE

Sigpro had designed a new PBX hardware platform based on the Intel IXP425 network processor. The design leveraged the High Speed Serial (HSS) interface of Intel's Network Processor Engines (NPEs) and included an Altera FPGA to accommodate custom logic. Peripherals included 10/100 Ethernet and an RS-232 connection.

When the first prototype was brought into the lab, the Sigpro team worked to get RedBoot and Linux up and running on the board. RedBoot was ported, but undiagnosed low-level hardware issues with SDRAM memory presented a roadblock, and the Ethernet interface to RedBoot was not functioning. These issues made it impossible to get a stable version of Linux running on the new platform. The lack of a useful 10/100 Ethernet interface meant that is was virtually impossible to quickly load new versions of code. This made testing and re-testing very difficult and slow.

While his team worked diligently to determine if the problem was a hardware or software issue, Chuck Cox, Sigpro's product development manager, sought a turnkey hardware test solution. He found Kozio's Web site and submitted a request for an evaluation copy of Kozio kDiagnostics.

KOZIO'S SOLUTION

Once Sigpro connected with Kozio, things moved ahead quickly. Cox saw the value of Kozio's manufacturing test solution, but when Sigpro CEO Mark Dzwonczyk spoke with Kozio, he learned about the company's experience with diagnostics for Intel XScale processors, including 12 similar boards during the previous nine months.

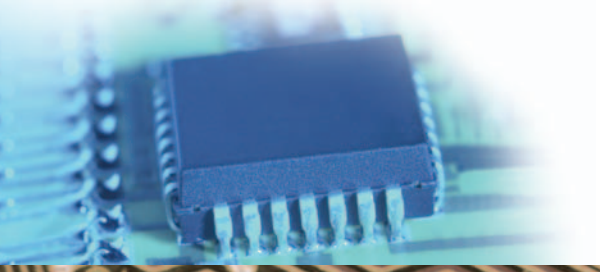
On a Monday, the Kozio team informed Sigpro that they could deliver a working comprehensive diagnostics solution in two days, and Sigpro agreed to move forward with the project. On Wednesday, Kozio had kDiagnostics up and running on the Sigpro platform, the first software to successfully run on the brand new hardware.

Kozio then provided training to the Sigpro engineers. Running kDiagnostics, Kozio demonstrated two separate failures, one with an Ethernet switch, along with single-bit memory corruption with the SDRAM memory. The SDRAM memory corruption, in particular, would be very difficult to debug using Linux. The Kozio kDiagnostics SDRAM burst test easily pinpointed the problem.

With just a couple of hours of training at Kozio, the Sigpro hardware engineers were using the scripting feature of Kozio's software platform to isolate the memory errors and learn more about their root cause. Scripting allowed them to customize the delivered test capability to isolate the error and repeat the failure quickly, leading to a much faster resolution of the problem.

Using Linux, it might have taken an hour to make changes to the board, do a new build, download, reload and repeat the failing test scenario. The flexible kDiagnostics interface allowed them to verify many different hardware registers, timings and parameters, then re-run the test in just minutes, permitting them to narrow in on the specific problem.

"The Kozio memory tests are incredible," noted one of Sigpro's hardware managers. "And on top of that, the scripting capabilities of kDiagnostics make all of the tests even more valuable for design verification."



Diagnostic information on what tests to run and the commands needed to do so were gathered by the Mountain View team and then sent with a board to a Sigpro hardware team in China. Meanwhile, the Mountain View team worked to resolve the Ethernet problem.

With a prototype board exhibiting the memory failure and Kozio's kDiagnostics in hand, the China team was up and running in four hours, recreating the memory failures. They were able to analyze the situation, make hardware changes and quickly rerun the kDiagnostics SDRAM memory burst test suite that pinpointed the memory failures. The test suite required just a few seconds to detect single-bit memory failures. This short test cycle was very repeatable and allowed the Sigpro hardware team to make changes and find resolution very quickly.

Kozio was also able to load and validate Sigpro's FPGA logic using kDiagnostics and an additional custom routine designed by the Kozio team. Using the scripting capabilities of kDiagnostics, Sigpro used an FPGA load command to transfer a Sigpro FPGA image from Flash to the FPGA component. Scripting was used to interface and drive the FPGA functionality, which resulted in the ability to pass data through the FPGA and light up LEDs.

Scripting allowed Sigpro to test out the FPGA in record time, avoiding the tedious cycle of writing, compiling, downloading and then testing new code. Using the kDiagnostics' interpreter, which ships standard with all Kozio software products, Sigpro engineers quickly tested various features of the FPGA from a command line. This saved weeks of effort loading and validating the capabilities of the FPGA code and design.

CONCLUSION

In two weeks time, Sigpro went from non-working hardware to contacting and partnering with Kozio to fully validate and fix two key hardware issues. Once again, Kozio's products and services helped quickly validate a new hardware design and save weeks of effort trying to use boot loaders or Linux to debug hardware.

In addition, Kozio's experience allowed Sigpro to validate new hardware to make it stable in record time, as well as providing a usable boot loader, Linux kernel, and specialized FPGA code, saving months of code development, unit testing and integration effort.

TIMELINE

THURSDAY:
- Sigpro requests Kozio kDiagnostics evaluation kit.

FRIDAY:
- Kozio delivers evaluation kit.

MONDAY:
- Kozio speaks with Sigpro's CEO and his team.
- Plan created, Kozio will provide kDiagnostics and a RedBoot port for the Sigpro PBX hardware board.
- Sigpro emails over schematics.

TUESDAY:
- Additional phone conferences on Sigpro requirements.
- Kozio creates a port for the Sigpro PBX board.
- Sigpro ships first prototype board to Kozio.

WEDNESDAY:
- Board arrives at Kozio.
- Board is powered on.
- kDiagnostics is loaded via JTAG interface and is up and running on the board before noon.
- RedBoot port is completed and running on target.
- Pre-built tests validate entire platform, isolating design errors with the Ethernet interface and SDRAM memories.

THURSDAY:
- Sigpro visits Kozio to learn firsthand how to use kDiagnostics, then use the Kozio Ethernet test suite to isolate the core problem and make a hardware modification, and the Ethernet test suites then pass.

FRIDAY:
- Kozio delivers FPGA load and test capability, validating the latest FPGA logic.

BENEFITS & SAVINGS

Kozio kDiagnostics was able to resolve two challenging hardware issues that Sigpro was unable to tackle using Linux as a debugging tool, saving weeks of challenging hardware debug effort. Ultimately, Kozio was able to fully validate Sigpro's PBX board in two total days of engineering time.

Working with Sigpro, Kozio was able to help cut costs and save time throughout the board development process, including saving development time going from prototype to working board; saving time testing each instance of the working board; and reducing prep and test time once the board is being manufactured.

Kozio's Analysis

Following is Kozio's analysis of potential savings realized for a project like this, based on standard industry procedures and some conservative assumptions:

Software & Services Costs versus Internal Development Costs

It typically takes about 45 weeks of engineering time to prepare RedBoot and the Linux kernel, along with board bring-up costs and related tasks. Comparing the cost of those tasks with the cost of licensing Kozio kDiagnostics software, plus services provided by Kozio, produces a cost savings of approximately 130%.

Schedule Savings

Another way to examine ROI is to calculate time saved in the process. Kozio estimates that by using kDiagnostics software and Kozio's services, Sigpro was able to resolve these issues in approximately three-quarters of the time required using internal resources, delivering working hardware and Linux seven weeks faster for a 78.5% schedule ROI.

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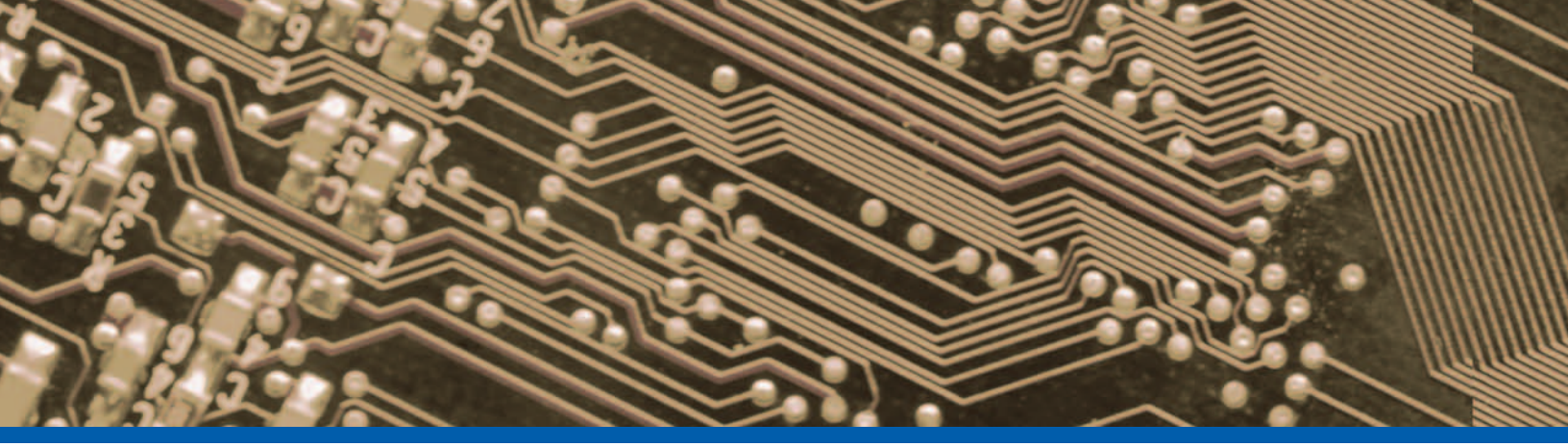
-a Sigpro hardware manager



Additional Savings

Additional benefits that Kozio clients realize by purchasing Kozio products and services include an efficiency increase in per-board validation, or the total time it takes to test out each board instance of the hardware design. Kozio kDiagnostics provided Sigpro with a standalone utility to quickly validate all PBX boards, saving hours of testing time per copy of the board. An entire board can be validated in 10 minutes using Kozio kDiagnostics. On average, it was estimated that Kozio software could save up to eight hours of testing effort per board, for a total overall savings for 10 prototype boards in excess of $4,500, assuming labor costs of approximately $60/hour.

Most important, by delivering RedBoot in one day and creating a customized Linux kernel in record time, Kozio enabled Sigpro to reign in its schedule, save months of development effort, and deliver working hardware and software to its client.

In conclusion, Mark Dzwonczyk, Sigpro's CEO, notes "Kozio kDiagnostics not only saved our team weeks of development time, they repeatedly prove their value as we continue with additional development. We have decided to ship all units with an embedded set of kDiags for self-test during the manufacturing process, which we are sure will deliver additional ROI as we ramp production."

Dzwonczyk continued, "In running Sigpro for 10 years, I have never met an outfit as responsive to a customer's needs as Kozio has been to ours. I have learned a lot about how to improve our business by watching Kozio respond and deliver to a customer under pressure."

For more information on Kozio kDiagnostics, visit www.kozio.com.

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