

# Synopsys and Cray

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**Mike Steinberger, Circuits Manager, Cray Inc.**

## Business

Cray Inc.'s mission is to deliver products and services that enable customers to solve their most challenging technical problems.

Cray systems are used to design safer vehicles, create new materials, discover life-saving drugs, predict severe weather and climate change, analyze complex data structures, safeguard national security, and a host of other applications that benefit humanity by advancing the frontiers of science and engineering.

## Issues

- Tight schedule for complex, high-speed SERDES design
- Lack of available in-house resources
- Risk created by an evolving new cell library
- Precise verification of critical custom logic

## Solution

- Synopsys RTL-to-GDSII design services
- Hybrid physical synthesis methodology combining the speed of automation with the flexibility of custom design
- Multi-level mixed-signal simulation for speed plus precision in design verification

## Benefits

- Greater confidence in design
- On-time project completion
- Time-saving methodology for future projects

### **Rigorous Requirements on a Tight Timeline**

With a contract, an architecture, and an extremely short schedule, Cray Inc. collaborated with Synopsys Professional Services to deliver a high-speed serializer/deserializer (SERDES) IP block that stretched the design limits of current technology.

The high-end supercomputers for which Cray is famous solve the most challenging computer problems on the planet: designing safer vehicles, creating new materials, discovering life-saving drugs, predicting severe weather and climate changes, analyzing complex data structures, and safeguarding national security. In addition to offering its own product line, Cray develops high-performance computing solutions for other companies. Its supercomputers excel in bandwidth, communication, and synchronization, making Cray the perfect choice to take on a design as challenging as this one for an important customer.

The SERDES block, consisting of four serializer and four deserializer channels, had to be fast, with a serial bit-rate of 2.5 gigabits per second and a clock rate of 1.25 gigahertz. It had to be very small in size and very low in power because hundreds of blocks needed to be integrated on a single microprocessor chip. “We were designing a circuit about half the size of most such circuits,” says Cray Circuits Manager, Mike Steinberger, whose organization is responsible for high-speed channels and custom circuits. While fulfilling a specific customer contract, the project also held strategic importance for Cray.

### **Commitment to Schedule**

With the clock running on an aggressive schedule and a shortage of available resources, Steinberger looked for outside assistance to take Cray’s evolving architecture from RTL to GDSII. “We use consulting services when necessary to meet program objectives,” explains Steinberger. “We needed a partner to take our circuit-level design and turn it into artwork that could be printed on silicon. Stated that way it sounds simple, but it’s quite a complex process, and we didn’t have in-house resources to devote to the effort.”

“Synopsys seemed a natural choice,” says Steinberger, “because Cray uses Synopsys tools and the two companies have a good relationship. Synopsys Professional Services was prepared to commit to the schedule.”

Access to a large and comprehensive set of advanced tools gave Synopsys Professional Services flexible resource bandwidth to mitigate risk and meet Cray’s schedule. And on-the-spot access to the tool developers enabled quick tool enhancements and rapid resolution of issues.

Starting with Verilog input from Cray, Synopsys carried out all aspects of the design implementation--synthesis, parasitic extraction, place-and-route, timing analysis, and simulation—in its Orlando, Florida, Design Center. At all times Cray had visibility into the process. The two organizations worked together as a team.

### **An Efficient Balance of Custom Design and Automation**

The performance requirements for the SERDES circuit demanded significant custom design. “Critical circuit functions needed to be laid out carefully because the available timing margin was so small. We wanted to work with someone who could place them the way we wanted, rather than letting a tool decide how to do it automatically,” explains Steinberger.

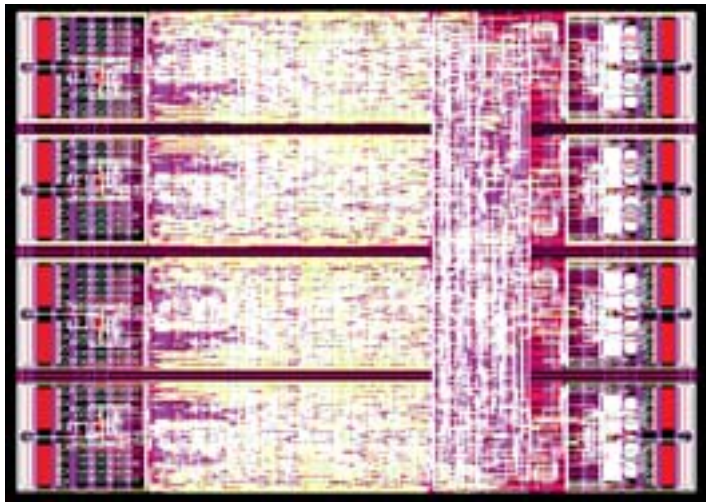
Synopsys gave Cray the design control it needed by creating a hybrid physical synthesis methodology that combined the speed of automation with the flexibility of custom placement, cell instantiation, and routing for approximately 15 percent of the design. With this hybrid methodology, Synopsys was able to reduce the time required for design iterations from four weeks or more to just one week.

The ability to turn around design iterations quickly proved important as the architecture evolved. Cray expected the new cell library it was using for the project to be stabilized early in the program. All went smoothly until the library vendor discovered mistakes in some cells. “Late in the program, we needed two additional design iterations to incorporate the changes,” recalls Steinberger. “Synopsys turned them around as fast as humanly possible, keeping the schedule on track.”

### **Playing with Time**

Because timing was crucial and timing margin extremely narrow for this high-speed circuit, Synopsys found ways to optimize placement for minimal wire length and delay. Synopsys also took extreme care with the clock tree to prevent disturbances caused by congestion and timing optimization. Instead of balancing the clock tree so that the clock arrives at each element at the same time, Synopsys deliberately introduced skew—allowing extra time between sequential elements that needed it at the expense of other sequential elements that did not require the full clock period.

This is just one example of how Synopsys worked with Cray to meet the technical challenges of the project. “If there was a problem, Synopsys knew exactly how to solve it, and things got done,” says Steinberger.



**Cray's Quad SERDES block**

**Multi-level Mixed-signal Simulation with Discovery-AMS:  
Speed Plus Accuracy**

The SERDES project required a mixed analog and digital simulation solution to verify performance. "We didn't know such a solution was possible until we worked with Synopsys Professional Services," says Steinberger. The Synopsys co-simulation solution combined the speed of gate-level simulation for most of the design with the detailed accuracy of transistor-level simulation for critical parts of the logic. Synopsys' Discovery™ AMS solution ties together the VCS™ HDL simulator and the NanoSim™ high performance circuit-level simulator to produce one unified simulation to verify the design.

"The NanoSim-VCS multi-level simulation environment produced quick results that allowed us to understand the behavior of certain critical circuitry with a great deal of precision," comments Steinberger. "This gave us greater confidence in our design." As a result, Cray plans to utilize this solution on future projects.

**Conclusion: A No-Nonsense, Get-it-Done Attitude**

From the beginning, Steinberger had confidence in the ability of Synopsys Professional Services to deliver on schedule, and that confidence grew as the project progressed. "The commitments and estimates Synopsys gave us were as accurate as they get in this business." He especially liked Synopsys' practical approach, which fits with Cray corporate culture. "Don't tell me about something fancy or elegant, just tell me how we can get the job done—that's my attitude. In working with Synopsys, it was no-nonsense. Things just got done."

As a result, Cray's customer is satisfied and Cray has gained valuable methodology expertise for future projects.

**For more information about Synopsys Professional Services visit us on the Web at [www.synopsys.com](http://www.synopsys.com), contact your local sales representative, or call 1.866.537.6654.**

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