ASTRON Reduces Time to Market with I/O Designer

As a producer of non-commercial, high-end equipment whose goal is to enable discovery in astronomy through innovative instrumentation and facilities management, Stichting ASTRON cannot afford delays in any of their projects. In fact, ASTRON’s ability to get their products to market faster is essential, as well as their ability to produce high-speed, consistent PCB schematics, layouts and FPGA designs.

Heightened Requirements

When the designers at Stichting ASTRON began planning their most aggressive printed circuit board (PCB) design to date, they knew right away that they would need better tools to accomplish the project. The Remote Station Processor (RSP) board would be faster, denser and more complex than anything they had developed to date. The RSP board would need to run at clock speeds in excess of 200 MHz instead of their typical 40 MHz. Its use of large, 1500+ pin FPGAs and the amount of data processing it would perform would require a very high density board. It would also require the use of low voltage differential signaling (LVDS) to save routing space and overcome signal integrity (SI) issues. In addition, the designers realized that their traditional way of manually assigning the FPGA pins, performing pin swaps and creating symbols would not be an option. They needed tools that could automatically create and synchronize the FPGA symbols and manage the FPGA pin assignments to optimize the performance and routing on the PCB. They found that ability in Mentor Graphics® I/O Designer within the Expedition™ flow.

A Tool to Tackle Challenges

I/O Designer™ is a tool that integrates the FPGA and PCB design flows and provides a fast and efficient solution for assigning I/Os on an FPGA, as well as creating the necessary symbols, schematics and hierarchical associations. It also acts as a data management tool, monitoring each flow and synchronizing any changes that occur, automatically. It was this ability to create the schematic symbols and assign pins automatically that saved ASTRON design time and allowed them to achieve their aggressive time-to-market goals.

"Before I/O Designer, there was no automated link between the FPGA design flow and the PCB schematic tool," stated A.
Doorduin, electronic design engineer, research and development, ASTRON. "Before, we had to do this all manually which took far too much time."

**A Test Design**

To ensure that I/O Designer was the product to handle this complex project, ASTRON first used it on a test project, called CubicB. This was a high-speed optical interface demonstrator that was developed to get experience building a PCB using BGAs with over 900 pins and a high-speed, high-throughput, 30 Gbps I/O. The project was a success and gave the designers at ASTRON the confidence to proceed with the larger RSP board project.

"From the I/O Designer point of view," explained H.J. Pepping, digital designer, ASTRON, "the demo board (CubicB) was a success. I/O Designer saved us many hours of checking and double-checking the schematics against the pinlist."

**The Real Thing**

The LOFAR (Low Frequency Array) project of Astron is a high-sensitivity astronomical imaging and detection instrument for low radio frequencies. A part of LOFAR is the RSP board where data from eight receiver modules is filtered in sub-bands and than beam-formed. Multiple RSP boards are linked in a chain by high-speed interfaces. Ethernet interfaces are placed on the boards for control and data transport to the Central Processor (CEP).

"The LOFAR system can be seen as the first radio telescope of a new generation," explains Gijs Schoonderbeek, electronic design engineer, ASTRON. "It employs large numbers of low cost, omni-directional antennas and high-speed digital signal processing to get high sensitivity and spatial resolution."

The LOFAR system, which the RSP board is a major component, posed many challenges to the ASTRON designers. First, the LOFAR system needed to process an enormous amount of data, to the tune of 800 DVDs per second. Also, the number and size of the boards becomes a serious requirement since they are going to be housed in numerous locations where either the boards must become smaller or more functionality must be available for each board. Finally, the costs per antenna play a bigger role in the project than in any other previous project.

The first step required that they switch their PCB design environment to Mentor Graphics Expedition PCB to take advantage of its ability to handle RSP's increased clock speed and LVDS requirements. Expedition PCB also enabled ASTRON to cope with the SI constraints related to the high-speed differential signals contained in the RSP board. This, along with I/O Designer's ability to handle the large FPGAs needed on the board, created an integrated design environment where all the design elements could be managed.

"To keep the FPGA and PCB design consistent," said Pepping, "we required a powerful layout tool and an automated I/O schematic assignment tool. This is where I/O Designer became crucial to the"
success of LOFAR."

"Because of the unambiguous relation between the pin assignment of the PCB schematic and the FPGA synthesis tool," continued Pepping, "no checking has to be done anymore. With Expedition PCB and I/O Designer, a structured design environment was created where a high-speed, high density PCB design was combined with the FPGA design."

Successful Implementation

So far, the RSP board and LOFAR system have been a success. The prototype was completed on schedule, even with the added time to learn I/O Designer from scratch, and work continues today on the final, full design. As future projects are planned and undertaken, the designers at ASTRON expect to see even more design time savings and improved time to market, as well as better overall designs.

"We have used the knowledge gained on the CubicB and RSP projects on other projects like TADU, a board for the Westerbork Radio Astronomic Observatory," stated Doorduin. "I/O Designer allowed us to create reliable schematic symbols which were not possible with other applications. It is now a common tool in our design.

For more information, contact 1-800-547-3000 (503-685-8000) or visit us on the web at www.mentor.com