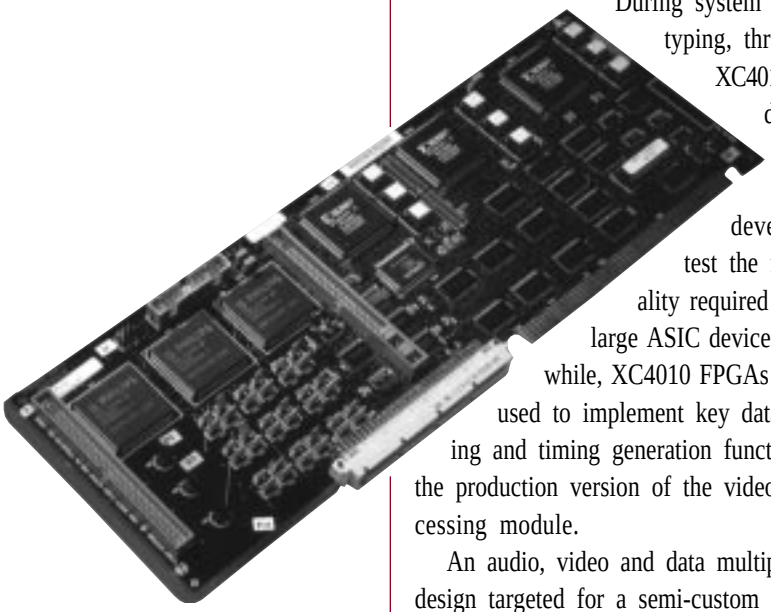
Videoconferencing with XC4000 FPGAs

GPT Video Systems (Maidenhead, Berks, U.K.) designs and manufactures high-quality videoconferencing solutions under the brand name FOCUS. GPT Video Systems is a long time user of Xilinx products; its designers use FPGA technology to maintain the flexibility and rapid time-to-market required in the fast moving multimedia market.

The flexibility of FPGA technology was evident in the design of the latest FOCUS videoconferencing systems, where XC4000™ series FPGAs were used for both prototyping and production applications.



During system prototyping, three XC4013 devices were used to develop and test the functionality required for a large ASIC device. Meanwhile, XC4010 FPGAs were used to implement key data routing and timing generation functions in the production version of the video processing module.

An audio, video and data multiplexer design targeted for a semi-custom gate array implementation was prototyped with three XC4013 devices. The development was carried out using Cadence Verilog software running on a Sun SparcStation. The FPGAs provided a fast and flexible development route, culminating in a fully-functional ASIC on the first try. The ASIC device holds about 30,000 gates of logic, with a 20 MHz system clock rate. Verifying the design with the FPGAs saved significant additional NRE costs and development time that would have been incurred if changes to the design had been required after committing to custom silicon. Furthermore, this development route allowed beta versions of the system to be shipped with the FPGA solution before production volumes of the ASIC were available, further accelerating time-to-market.

Three XC4010 FPGAs hold the majority of the logic in the video processing module in the main codec design. Two of the FPGAs share a common design and act as video routers, passing CCIR601 digital video data from various input sources to the desired outputs. Each device is designed to route data in the form of an 8-bit data bus, requiring two to be used for the 16-bit data in the CCIR601 format. Thus, one device handles the routing and control of the luminance data, and the other handles the chrominance data.

These two devices also perform the task of overlaying the graphical user interface directly onto the video outputs. This includes a patented function that produces semi-transparent video, allowing on-screen text to be displayed in an easily-readable format while not obscuring the live video beneath. The design makes specific use of the XC4000 architecture's on-chip RAM capability to implement fast look-up tables.

The third XC4010 FPGA in the video processing module is a timing generator, providing all the timing functions for the various video field store read and write operations. This FPGA also contains the state machines that control the reading and writing of captured video images to and from the graphics frame stores.

The XC4010 designs were entered using a combination of schematic capture and ABEL hardware descriptions and verified with the ViewSim simulator, using a PC-based Viewlogic environment. All three FPGAs are about 80% full and run at a system clock speed of 13.5 MHz, a

performance level that was easily reached using timing constraints and automatic placement and routing tools.

To further reduce hardware costs during volume production of the codecs, the XC4010 FPGA designs were frozen and converted into HardWire™ XC4310 devices. Since the HardWire devices are pin and function compatible with the FPGAs that they replace, system flexibility is maintained; the HardWire devices can be replaced with newly-designed FPGAs if the design evolves at a later date. According to Richard McCandless, Project Leader at GPT Video Systems, "The HardWire conversion went extremely well, with very little engineering effort required at all, and they came in on time! In fact, it surprised us how little engineering effort was needed."

As noted by McCandless, "These video interface designs were fairly complex, but the FPGAs proved to be very flexible and easy to work with. The high level of integration provided by the FPGA devices has helped to create the most user-friendly graphical user interface in the video-conferencing industry." ◆