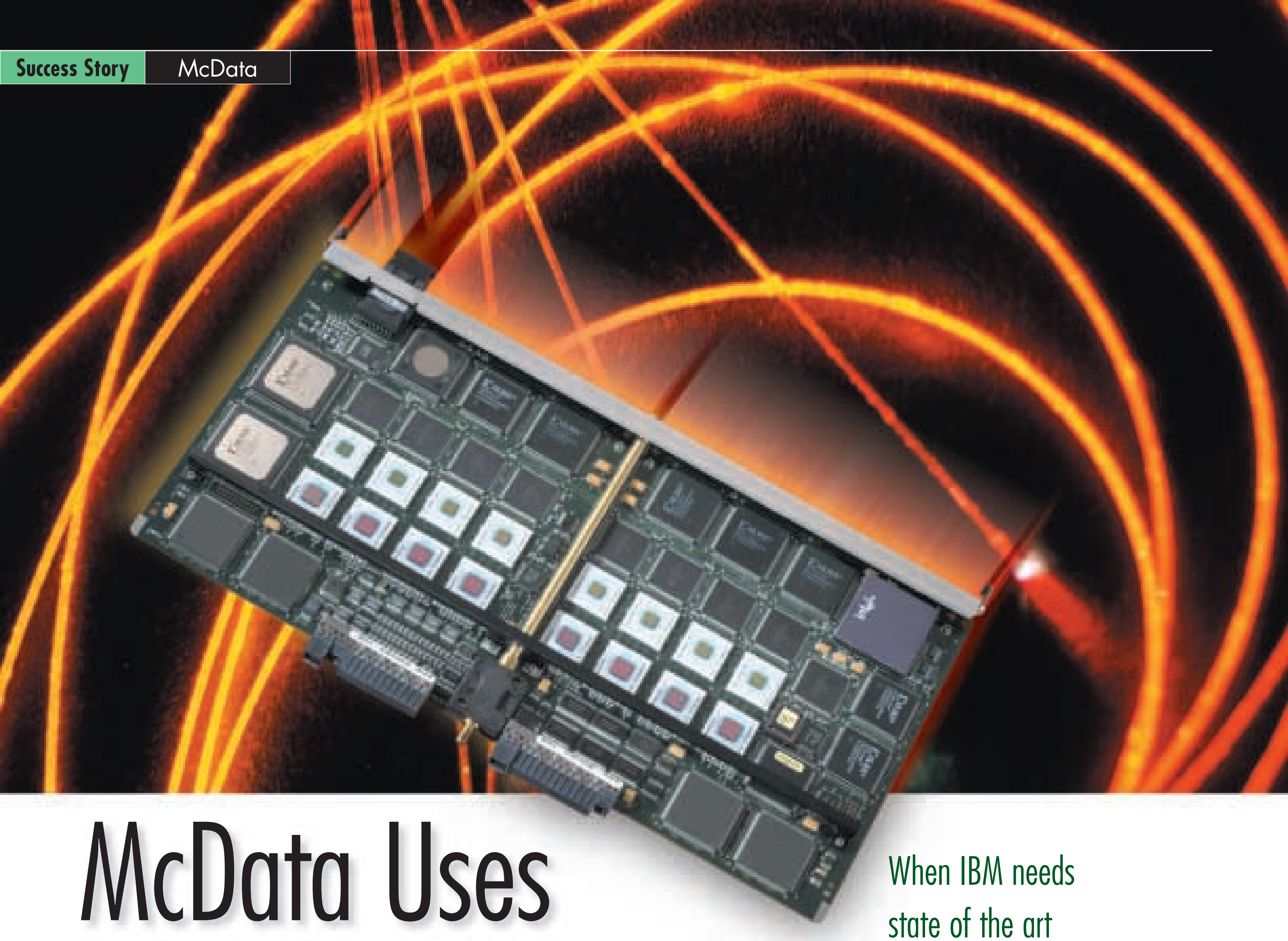

McData Uses Xilinx FPGAs for Fibre-channel Switch

When IBM needs state of the art Fibre-Channel hardware, it thinks McDATA. When McDATA needs FPGAs, it thinks Xilinx.

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McDATA Corporation, headquartered in Broomfield, CO, is the architect of the first enterprise-wide SAN (Storage Area Network) solution. McDATA specializes in highly available, scalable and centrally managed enterprise SANs, providing customers with hardware and software that allow dynamic connection between the data center and edge servers in large enterprise data centers. McDATA also offers design, implementation planning, integration testing, and training services for companies building enterprise SANs.

Designing a Bridge Card

In the late 1990s McDATA designed a 128-port 9032 Model 5 Director for IBM- a super switch for interconnecting mainframe computers and high speed peripherals like disk and tape arrays. IBM came to McDATA again when the company needed an internal bridge card to manage the optoelectronic, framing, and format conversion from newer, IEEE One Gigabit Fibre-Channel connections (or FICON) for the 9032 (Shown in Figure 1). Originally designed with the 200-Megabit ESCON protocol in mind, to the Model 5 would be the first of IBM's switches to support FICON.

Each new bridge card would perform the work of up to eight ESCON channels. Up to 16 FICON Bridge cards (equivalent to 128 ESCON ports or one half of the Model 5's capacity) would be supported in a single 9032 Model 5 Director.

Retrofitting the FICON bridge card would allow data centers to use the much higher speed of FICON without replacing the 9032 Directors. It would also give IBM's customers the ability to optimize for either raw speed or through multiplexing larger arrays of storage devices. Except for the costs associated of the bridge card itself, upgrading the Director would be nearly painless, and conserve the customer's investment in a costly piece of high-performance hardware-the 9032 Model 5 has a backplane with full-duplex, 1-Gigabit capacity.

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Choosing FPGAs Over ASICs

Roughing out the block diagram for the new FICON card was straightforward. The bridge card would handle multiplexing and format conversion; IBM would perform protocol conversion in the mainframe. The 1-Gigabit optical input is steered to an optoelectronic converter, and from there to a 32-bit, 26-Mhz parallel bus. Next is a framer, then a Fibre-Channel high-level protocol converter, followed by eight IBM-supplied ESCON engines the output of which connect to the 9032 Director's backplane.

Xilinx FPGAs form the heart of the bridge card's framer and protocol conversion sections. Originally, an ASIC had been targeted for these roles. But ASIC development is risky and time consuming and project engineer Paul Hwang needed to minimize risk and get the product to market as quickly as possible. Hwang decided to use Xilinx FPGAs and design tools rather than develop an ASIC. The team would take advantage of FPGA reprogrammability to design, develop, and debug as they went along.

Using multiple FPGAs sped up the effort further. McDATA found that by partitioning the design into modules, each with its own FPGA, they could assign each part to a different designer or team for easy to manage and faster parallel development.

Xilinx FPGAs were also valuable because there were so many unknowns in the project. In fact, once the decision had been made to use FPGAs, McDATA decided to optimize the bridge card architecture around them, to get the most out of the programmability. This helped minimize the impact of specification changes, bugs, and implementation changes. Use of the FPGAs drastically cut development risk, and development moved along far faster than the ASIC approach.

"We knew Xilinx' product philosophy, having been a Xilinx customer for five years, and were very comfortable with it and with the company's product," says Hwang . "It was McDATA's positive experience that made Xilinx the choice of the engineering team. They also knew that they didn't need to push Xilinx technology; there was capability in reserve."

The Design Process

The design process went smoothly using standard Xilinx Alliance Series(software tools. "We used the scripting capabilities to the fullest so that we could automate as much of the process as possible," says Hwang. In addition, McDATA used the Xilinx EPIC FPGA editor to help debug the design by bringing out internal signals to unused I/O pins, something that would not have been possible with an ASIC—another time saver and another advantage of the FPGA approach.

McDATA used several different Xilinx products to implement the bridge card, among them the XC4013XL, XC4028XL, and XC4044XL FPGAs, and an XC9500 CPLD. The CPLD was used to interface to an Intel i960 processor which downloaded the bitmaps into the FPGAs. As the design evolved, McDATA started with relatively large FPGAs, but as they altered and optimized the design, they moved to smaller die sizes especially with respect to the XC4013s. McDATA is also moving to Xilinx XLA technology FPGAs to "greatly help with cost reduction, while continuing to minimize program risks," according to Hwang.

The process went so well that McDATA is sticking with its original FPGA implementation, especially since this allows for the design to be further refined. As is usually the case, McDATA originally anticipated going to an ASIC to minimize costs. But now, production of the FICON Bridge Card is well underway using Xilinx FPGAs. The cost reductions made using Xilinx XLA-class FPGAs have been significant, and consequently, there are no immediate plans to switch to a custom chip.

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Conclusion

Looking back on the development Hwang says, "The risk was too high with the ASIC approach. In hindsight, we made exactly the right decision to go with Xilinx FPGAs."