intel ®

Intel in Communications

Case Study: ATTO Celerity* Fibre Channel Storage Adapters

Intelligence at the Edge of the SAN

Summary

Jumping ahead of the development curve, ATTO Technology has introduced a line of adapters that help solve the advanced storage connectivity problems of the future. Anticipating the connectivity requirements that will result from the changing Storage Area Network (SAN), ATTO engineers designed intelligence into the company's new line of Fibre Channel Storage Adapters.

With processing features not found in the typical Host Bus Adapter (HBA), the new Celerity* Fibre Channel (FC) product line enables higher levels of performance and new capabilities at the edge of the SAN. This case study looks at the reasons ATTO chose to reposition its new HBAs as "storage adapters" and the pivotal role played by the highly integrated, new Intel® IOP331 I/O processor, based on Intel XScale® technology.

The Changing SAN

Among the many catalysts for change in the storage industry are demands for ever-increasing capacity, bandwidth, and memory. Greater data protection requires more pervasive levels of fault tolerance, failover, Xcopy backup, etc. New applications and new technologies make storage more useful throughout the network, increasing demand for flexible, scalable systems.

To address these issues, vendors are building more versatile platforms that offer more capabilities within a single device. Such system changes also affect the infrastructure design, leading some vendors to question long-established tenets of the storage industry, such as the traditional one-way host-to-target relationship. For example: What new applications and functions might be possible if "targets" behave as "hosts," and vice versa?

Recognizing that the SAN requires more intelligence, the location for such capabilities is also up for debate: Should it be in the middle, edge, or both? These issues all require fresh storage solutions at new levels of performance – both volume and transactional in nature.

Rethinking Host Bus Adapters

As a result, some of the most basic devices must be reconsidered. Host Bus Adapters (HBAs) sit at the transaction point between the Fibre Channel storage network and the IP data network. ATTO Technology believes HBAs must be redesigned to optimize the other changes taking place in the SAN, lest performance gains be lost at the network edge.

Increasing bandwidth might not be enough to meet these needs. For example, traditional Fibre Channel HBAs rely on the host system's bus memory and CPU to process the transfer
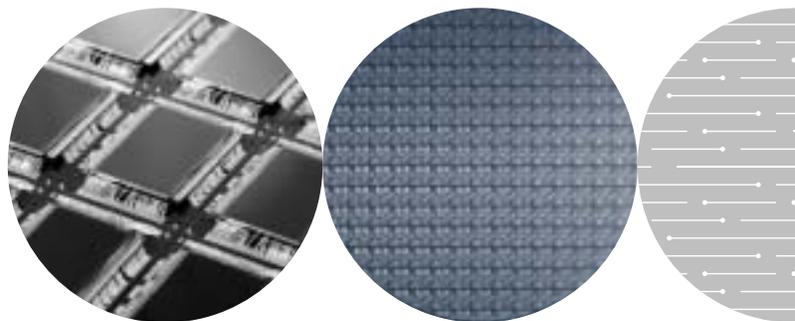
of data between host (servers) and target (storage). Bottlenecks are common, since the HBA burdens the CPU by "borrowing" its memory, potentially slowing it down and making it unavailable for mission-critical applications. It can also take longer to get data to applications since it must bounce between HBA and system memory. Additional bandwidth alone can't fix these problems.

ATTO says that the typical host-to-target relationship is another design limitation in traditional HBAs. Because the immutable laws of storage specify that the host must always behave as an initiator, and storage must always behave as a target, management solutions within the storage box are limited. ATTO engineers wondered: What if this relationship was changed, so that hosts and targets can behave as one or the other? The storage box could perform advanced operations such as failover, load balancing, virtualization, etc. Such advanced storage management solutions are typically only available through very costly systems.

According to ATTO, this is precisely why intelligence is needed at the edge of the SAN. Changing the

design of the HBA to include native intelligence would solve the CPU offload issues and eliminate common bottlenecks. At the same time, intelligent HBAs can enable new applications and new methods for data handling right where it's most effective.

All of which led ATTO to develop a new category of HBAs dubbed "storage adapters." Unlike traditional HBAs that run the one-way host-to-target connection, ATTO's Celerity FC adapters are defined by the changing needs of the SAN, such as the demand for intelligence at the edge. With ATTO's new storage adapters, the options go beyond connectivity.

Design Criteria

ATTO planned the first series of storage adapters using the popular Fibre Channel technology. Later versions are expected to support iSCSI and other standards. ATTO defined the goals for the product line as follows:

- Build a product family that maximizes ATTO's hardware and software expertise to deliver a platform for advanced storage connectivity.

- Provide a timely upgrade path for new technologies.

- Simplify and augment advanced network storage needs such as switching, backup and data management.

- Support third-party SAN and backup software packages.

- Add value and intelligence into the hardware to strengthen software edge support.

- Deliver the entire Fibre Channel version of the product line at one time to help simplify development of comprehensive storage solutions.

Although there are three cards in the newly launched product line, the product family leader was the Celerity FC-24XL quad channel adapter. Because its more complicated design required a longer development cycle, this product became the focus of the company's engineering efforts. Delivery of the entire product line hinged on the success of the 4-port card.

During development, ATTO sought components that offered a solid, forward-looking roadmap. With an eye down the road, ATTO engineers calculated that future versions of their new product line would reap significant time and cost-savings by leveraging the work done on the initial designs. Finding suppliers that offered long-term stability was also important.

Intel® IOP331 I/O Processor

The Intel IOP331 is a highly integrated I/O system on a chip for I/O-intensive storage, networking, communications and embedded applications. High integration saves board space and system-level cost savings. Integrated in the IOP331 are an 800 MHz CPU, a high-performance internal bus, a dual-ported memory controller, a high-bandwidth PCI-X-to-PCI-X Bridge, and an improved interrupt controller.

As Intel's sixth-generation I/O processor, the IOP331 continues to build on Intel's strength in delivering high-performance, low-power Intel XScale® technology processors. The IOP331 is code compatible with the previous generation Intel IOP321 I/O Processor, other Intel XScale core processors, and ARM*-based devices, simplifying code porting from existing designs. Significant improvements to the interrupt controller help reduce interrupt latency. The DDR SDRAM dual-ported memory controller, which supports both DDR 333 and DDRII 400, provides ultra-fast memory transactions, further enhancing performance in I/O-intensive applications.

In the quad channel design, high performance was required so that key functions could be moved from the host CPU to the adapter. It also needed a PCI-X bridge to meet the latest technology requirements for both host and fabric devices.

The Solution

During the search for components, the ATTO engineering team discovered a highly integrated I/O processor with a built-in PCI-X bridge: the Intel IOP331 I/O processor. "Its 800MHz Intel XScale core, built-in DDR memory interface, and PCI-X bridge made it the perfect fit," explained Barry Debbins, ATTO's Director of Hardware Engineering. "With a single processor, we could deliver the necessary intelligence, performance, and scalability that the changing SAN market required."

The Results

ATTO engineers had to consider the development effort necessary to implement the features needed to support the changing SAN market segment. The entire Celerity product line was intended for release as a family. ATTO relied on Intel to get the whole line out – three products in the time it normally takes to do one. "Intel helped make it happen," said Mario Appiani, ATTO's Manager of Hardware Development.

With the processor selection complete, the challenge became getting a new technology out in a timely manner. And that's where the decision to use the Intel IOP really paid off. "Intel gave us access to critical documentation and support personnel to assist in the hardware design," said Appiani. "What's more, since ATTO had developed other products using the Intel XScale-based I/O processors, porting the software design to the new Celerity adapter using the newer IOP331 was straightforward."

Appiani goes on to explain, "By leveraging the high level of integration and performance on the Intel XScale-based IOP331, the Celerity FC-24XL achieved something much bigger than traditional Fibre Channel adapters – triple the performance and capabilities, with just a small increase in cost over a basic PCI-X bridge. Also, the Celerity FC-24XL opens new design opportunities for OEM customers by providing them the opportunity to utilize the IOP331 for running third-party applications."

Celerity Features and Benefits

ATTO's new Celerity storage adapters use the company's industry-leading technology – including Advanced Data Streaming (ADS*) Technology, signal protection and user-friendly configuration utilities – and wrap it around industry-standard Fibre Channel and PCI-X connectivity.

The Celerity FC-24XL storage adapter immediately addresses important needs in the changing storage industry: moving storage-related functions such as Xcopy backup from the CPU to the adapter and adding intelligent switching anywhere in the SAN. Both of these functions increase the performance of the storage system and open up a whole realm of advanced storage management solutions that rival more costly traditional alternatives.

ATTO's unique Integrated Offload and Processing Center (IOPC*) included in the quad channel adapter provides additional processing and buffering, thereby reducing server CPU usage. Offering a platform for additional capabilities, the FC-24XL is ideal for customers who need to simplify their SAN fabric or require more intelligence at the edge of the fabric.

The capabilities enabled by the IOPC include: port-to-port data streaming, onboard buffering and caching

The Celerity* Quad Channel (FC-24XL) Storage Adapter

The Celerity FC-24XL is a Fibre Channel Advanced Storage Adapter providing four independent channels of 2-Gigabit connectivity to simplify SAN fabric design. With the highest port density available today and unique performance and features available only from ATTO, the Celerity FC-24XL allows the movement of intelligence and data manipulation to the edge of the fabric.

At the heart of the Celerity FC-24XL is the Integrated Offload & Processing Center (IOPC). Using the Intel IOP331 I/O processor with the Intel XScale core and an internal 133 MHz PCI-X data bus for top performance and low latency, the Celerity FC-24XL IOPC can be adapted to perform a variety of high-value functions that take advantage of onboard buffering and processing. These capabilities include data stream manipulation, direct port-to-port transfers, offload processing, video handling and other custom advanced functions.

of data, backup offload and processing, metadata insertion or data manipulation on the fly, data protection and security algorithms, and video handling. All of these CPU-intensive applications can now be completed on board the FC-24XL because of the architecture that leverages the high performance, high integration available on the IOP331.

An idea of the new capabilities provided via the IOP331 can be illustrated with the adapter's port-to-port data streaming. "We can provide a Windows* API to map the FC-24XL into user and system space. So an application could generate read and write requests that never use host memory. This has interesting implications for high bandwidth applications," explains Debbins.

What's Next?

"Our entire company is excited about the IOP331 and the new Celerity product line. We can't keep these cards in the lab. Other design groups are using this for a Linux* platform. And we're looking at this chip for future generations of our Celerity products," says Ed Tierney, Director of Product Management, ATTO.

With the design flexibility built right in, and the inherent scalability of the IOP331, ATTO has the ability to take the FC-24XL adapter and create different "flavors" of the same product. For example, some of the company's customers are asking if ATTO can produce the quad channel adapter in an iSCSI version. "The flexibility of the Intel XScale core is key. It's amazing that we could take a little bridge adapter and make it into something really cool," says Tierney.

For More Information:

About Intel® Storage Building Blocks
www.intel.com/go/storage

About Intel® I/O Processors
developer.intel.com/design/iio

About ATTO Technology
www.attotech.com

About ATTO Celerity Fibre Channel Storage Adapters
www.attotech.com/celerity.html