



## Case Study: LSI Logic Corp.

### RAID Controllers Capitalize on Intel® I/O Processors for Integrated Functionality, Leading-Edge Performance, Faster Time-to-Market

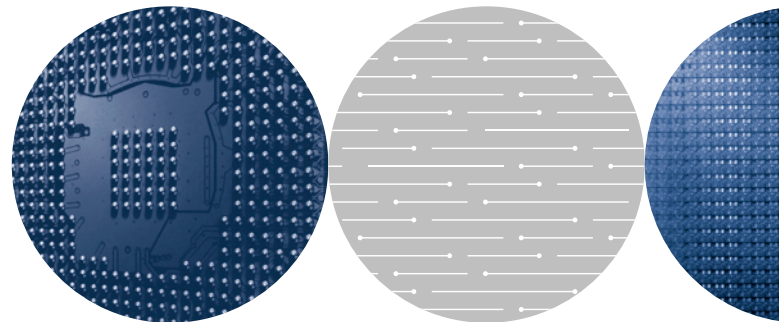
#### Summary

OEMs worldwide rely on LSI Logic Corp. to deliver high-performance, industry-leading, fault-tolerant storage solutions. Maintaining that business means continually developing better products that build on proven technologies, while growing that business means being ready with new products as the latest technologies emerge. On both fronts, LSI must keep its price point low—or risk losing customers to competitors that can.

To help address these challenges, developers in LSI Logic's RAID Storage Adapters Division are building direct-attached RAID controllers powered by Intel® I/O processors. Intel IOPs give LSI the ability to implement RAID in a cost-effective manner by combining all needed functionality into a single integrated package.

Aiming to take a leadership role in the fast-growing Serial ATA (SATA) marketplace, LSI has developed a line of powerful SATA RAID controllers that meet aggressive time-to-market, price, and performance requirements through a design based on the Intel® IOP302 I/O processor. Also on LSI's production line is a family of next-generation SCSI RAID controllers based on the Intel IOP321 I/O processor—the first I/O processor to integrate Intel® XScale™ technology and a PCI-X\* interface. Porting its firmware to Intel XScale technology offers LSI a streamlined and cost-effective way to meet OEM demand for ever-faster I/O throughput.

This case study examines how Intel IOPs enable LSI developers to offer tier-one OEMs and other system builders high-performance data redundancy at a lower cost.



## Background: Fault-Tolerant Storage Adapters

In the RAID Storage Adapters (RSA) Division of LSI Logic, success is all about being competitive. The group's primary business is selling host adapter boards that plug into servers and workstations, providing OEMs, system integrators and VARs with powerful, integrated, direct-attached RAID storage solutions.

LSI's biggest customers in this marketplace are many of the major OEMs in the United States, Europe, Pan Asia, and Japan. Under pressure to keep their costs down, these industry-leading customers constantly drive LSI to reduce costs. As a result, developers at LSI understand that their greatest challenge is to deliver high-performance, fault-tolerant storage adapters at the lowest possible price.

## Meeting Customer Demand, Driving Market Growth

LSI Logic recently recognized a market opportunity in Serial ATA, a new interface that offers developers the potential to move to a lower-cost, higher-performance interface than has previously been available in the IDE or Parallel ATA world. Serial ATA has already proven to be a more reliable interface than Parallel ATA, and LSI expects it to replace Parallel ATA over the next several years as prices decline. LSI also believes that Serial ATA will spur growth at the low end of the market. Thus, the company wanted to develop products targeted at that segment and bring RAID functionality into the lower cost arena. But seizing the Serial ATA market segment opportunity presented a challenge for LSI: How to transition to Serial ATA products while meeting aggressive time-to-market and performance requirements.

To address a different vector of customer demand, developers at LSI Logic sought a next-generation CPU technology to power the company's newest fault-tolerant SCSI storage adapters. LSI Logic planned to come to market in 2003 with a line of high-end SCSI RAID controllers for enterprise servers and high-performance workstations, with the powerful data throughput, extensive fault-tolerant capabilities, and advanced management

utilities demanded by leading system manufacturers. Besides requiring a processor optimized for high I/O efficiency, LSI developers wanted a robust growth path to future-generation RAID storage adapters.

LSI Logic's RSA division has been successfully designing around Intel I/O processors since the mid-1990s—even the company's first-generation RAID products were based on Intel IOPs—so it made sense that developers would look to Intel when designing LSI's newest RAID storage solutions.

“Our most successful products have been built around Intel I/O processors,” says Jim Evans, product marketing manager for LSI Logic's RSA division. “There's definitely a profitable connection between our business and Intel IOPs.”

## Next-Generation Solutions Built on Intel® I/O Processors

To enter the market quickly with high-performance, cost-effective Serial ATA RAID controllers, LSI decided to build its new products on Intel IOP302 I/O processors. By late spring of 2003, LSI had begun shipping two boards that offer powerful SATA RAID functionality for server, workstation and network storage environments—the MegaRAID\* SATA 150-4 RAID controller, with four Serial ATA 150 I/O ports, and the six-port MegaRAID SATA 150-6 RAID controller.

Using Intel IOPs helped LSI Logic streamline its time-to-market by combining complete, full-featured RAID data protection, superior performance and affordable price in one integrated package.

“We have used other I/O processors in the past, but in general Intel offers us the best solution and price for the functionality that we need,” says Gerry Smith, senior director of software engineering for LSI Logic's RSA division. “Plus, Intel is on the leading edge of performance for IOPs. But the biggest advantage to us is that it's a total solution. The Intel IOP gives us all the pieces we need to implement RAID functionality in our product, including the CPU, the XOR engine, which we use for parity generation, the DMA controller, the Address Translation Unit, and the peripheral memory components and controllers.”

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**Jim Evans**  
Product Marketing  
Manager, LSI Logic Corp.

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Senior Director of  
Software Engineering,  
LSI Logic Corp.

To launch LSI Logic’s next-generation SCSI RAID controllers, developers ported their firmware to an I/O processor based on a next-generation technology: Intel’s IOP321 I/O processor. “The IOP321 offers much higher performance,” Smith says. “The design of the core CPU is such that it can be made to run faster than the core Intel i960® chip-based CPU product, so it provides a better growth path for future performance gains. It’s also based on the ARM\* instruction set, which is widely understood by programmers and has significant tool support. So it’s well known, it’s well understood, it’s very flexible and can be extended to be very fast.”

By August 2003, LSI expects to be in full production with two new products based on the IOP321—the dual-channel MegaRAID SCSI 320-2X RAID storage adapter and the four-channel MegaRAID SCSI 320-4X RAID storage adapter. Both PCI-X-compliant SCSI RAID controllers are designed to provide high-I/O performance and data protection for servers and high-end workstations.

These products are the latest—but not the only—RAID controllers that LSI Logic builds on various versions of Intel IOPs. The company is also working closely with Intel on upcoming versions of processors and plans to implement IOPs under development at Intel in future LSI products, particularly those based on PCI Express\*. That insistence on best-available components is a large part of what makes LSI the solution of choice for customers.

## Advantages in the Development Shop

Along with streamlining time-to-market, Intel IOPs offer LSI Logic the benefit of reduced engineering and development costs. For example, having all needed functionality in one compact, integrated part saves on component costs and board “real estate” costs. Fewer parts means LSI can keep the card size down, and production costs are significantly lower than they would be if LSI had to purchase and assemble multiple parts. In addition, Intel’s emphasis on architectural commonality in IOPs allows LSI developers to capitalize on their existing code base.

“When Intel adds new technology and evolves to next-generation IOPs, there’s usually not a lot of change in the high-level architecture of the part,” Smith says. “That means we can leverage a good portion of the firmware and software that we write on one product family when we move to our next product family, and concentrate on the newer features the IOP offers and the higher performance levels. Having used Intel products for a while, that pays dividends for us.”

Another benefit that developers realize is proven performance between Intel IOP hardware and LSI RAID software. “Performance is always a big thing for us, and we’ve spent a lot of effort over the years optimizing our firmware to run very fast on the Intel part,” Smith says. “Intel IOPs also give us a lot of internal capabilities to monitor and optimize performance.”

LSI developers also point to ease of use as an advantage of Intel IOPs. Developers use many of Intel’s extensive programming tools, such as compilers, and speak highly of the product documentation.

“Intel is far better than any competitor in terms of the completeness of the documentation,” Smith says. “We’re able to get the data we need because the documentation is complete and accurate. And the different components in the chip have a sensible design, so I find them easy to understand and easy to implement. We also work very closely with the Intel engineering teams during the development processes, and the support people we work with at the Intel factory are very responsive. If we have issues or questions, they respond immediately and they investigate and drive issues through to closure.”

LSI developers see another advantage in the fact that Intel IOPs integrate standard interfaces such as PCI and PCI-X. Smith notes that Intel does a great deal of validation to ensure that its solutions follow standard protocols and are compatible with industry standards.

“That gives us a robust product that we can plug in to virtually any system,” Smith says. “And from a hardware perspective and a protocol interface perspective on PCI, PCI-X and so forth, we know that it will work.”

## Conclusion

Using Intel IOPs enables LSI Logic to shorten its time-to-market by combining complete, full-featured RAID functionality, superior performance, and affordable price in one integrated solution. It's a combination that helps LSI maintain and gain market share by keeping a lid on development and engineering costs—savings that can be passed on to OEMs.

“A big portion of the solution is built in the Intel IOP, and by using the IOP, we can reduce our total cost,” Evans says. “We can get all the functionality we need in a cost-effective package.”

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