



Case Study

Areca, Inc.

Intel® IOP341 and IOP342 I/O Processors
RAID 6 Host Bus Adapters for High-
Performance Storage Systems

Areca Develops a Single HBA Solution to Match up with High-Performance Storage Systems

Important features include: Hardware-based RAID acceleration, dual-core processing, support for both PCI Express* and PCI-X* interfaces

Case Summary

Challenge

The increasing performance of storage systems has not been matched—on scale or pace—by the performance of RAID host bus adapters (HBAs). It takes at least two HBAs to create the I/O throughput needed to support systems based on 10Gbps iSCSI, Infiniband* and Dual 4 Gbps Fibre Channel technology. Yet when it comes to HBAs and RAID, it is very difficult to combine two or more into a single solution. Cross-system striping, RAID 6 dual-parity schemes, and the need for multiple bus slots means that multiple HBAs are rather inefficient as a means to deliver RAID. What OEMs need are single RAID HBAs that can keep up with the performance pace with the storage networks of today.

Solution

The new Areca ARC-1280 PCI Express to SATA II and Fibre to SAS Host Bus Adapters meet this need with extremely strong performance and a sustained transfer rate greater than 776 MB/sec.[£] Several design efficiencies combine to enable these performance metrics, including hardware-accelerated RAID, a new DDR memory bus architecture, and dual-bus configurations, including the addition of a PCI Express* bus. Most of these features are made possible by the Intel® XScale® architecture-based Intel® IOP341 and two-core Intel® IOP342 I/O processors, which Areca credits with providing the massive throughput needed to close the performance gap.

HBAs Fall Behind in Speed Race

Storage systems today come with massive throughput capabilities—10Gbps iSCSI, dual 4Gbps Fibre Channel, or Infiniband* network connectivity. They need this much performance to handle all the data that comes their way. They also need a high data transfer rate—both read and write functions—to maintain overall system performance.

But there's a very important step that occurs when data is transferred from the storage system to the server via the host bus adapter (HBA): RAID. With increasing emphasis on data protection in business today, RAID solutions are becoming mandatory in new equipment.

Yet there is a mismatch in performance between existing RAID HBAs and these super-computing storage systems. These environments need 800 MB/sec or higher performance from the RAID card to maintain

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throughput and efficiency. Because they also use non-linear editing—to further increase performance output—they rely on RAID cards to reduce the image output schedule. Yet most RAID HBAs can deliver only 300–400 MB/sec performance. Well short of what's necessary.

Closing the Gap

One solution might be to add two or more HBAs to a server or storage system. But that requires more bus slots. Plus, "It isn't easy to stripe the data across different adapters. You need to create the volume set in each adapter, and then span those volume sets across the system," explains Billion Wu, CEO of Areca Corporation. "Each adapter needs its dedicated parity. High-performance storage systems need more slots and parity disks to get the same result. But there are few systems with enough available independent PCI-X* slots."

Even then, PCI-X no longer offers the needed throughput for today's 10Gbps iSCSI, dual 4Gbps Fibre Channel and Infiniband network connectivity. Instead, PCI Express* is needed to support larger disk arrays and RAID 6—both increasingly important as businesses become more focused on data protection.

Today's server motherboards provide at least three PCI Express x8 slots, which is needed to support larger 24 disk SATA arrays in storage. The RAID HBAs must be able to support the performance coming out of these systems, especially to ensure no loss of data when two disks crash simultaneously.

Therefore, the industry requires new RAID HBAs that can effectively match the high-performance delivered by storage systems today. Those cards should be developed with several very important features, including:

- PCI Express bus to the server, and in some cases a two-bus configuration with one PCI-X slot as well.
- Hardware-accelerated RAID, and onboard chip support for all RAID levels, including the dual-parity scheme in RAID 6.
- Enough performance in a single RAID HBA to support the throughput of 10Gbps iSCSI storage systems and other high-performance arrays.

Areca Comes Through

Areca is believed to be the first to develop a single RAID HBA that meets all of these performance requirements—and then some. Two versions of the Areca ARC-1280 RAID HBAs—one for PCI Express to SATA II and the other for Fibre to SAS—provide the necessary sustained performance and RAID 6 dual parity support for the high-speed network connectivity provided by storage systems at work today.

For example, the new Areca ARC-1280 enables one PCI Express motherboard to support up to 24 SATA II drives with just the one

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HBA. It is believed to be the first HBA in the industry to support such performance and capacity.

The ARC-1280 includes a dual-bus configuration—with one PCI-X bus and one PCI Express bus—which allows the host and drive CPUs to work independently. "The host activity will not disturb the drive activity, which dramatically improves overall RAID and system performance," explains Wu. "Traditional single bus or bridge architecture requires the host and drive CPUs to share access, which downgrades total bus performance."

The Areca ARC-1280 RAID HBA is based on the Intel® IOP341 I/O processor with a single Intel® XScale® core, supporting the card's dual-bus configuration with both PCI-X and PCI Express. This architecture can push the ARC-1280 controller to the highest levels of performance. For example, in Areca's internal performance tests, the ARC-1280 takes advantage of onboard hardware RAID 6 acceleration to deliver sustained throughput of 776MB/sec Reads. At RAID 5, the performance is even greater, at 811MB/sec.^f

In addition to the Areca ARC-1280 RAID HBA, there are a few other Areca products based on the Intel® IOP341/342 processors. This includes the iSCSI-to-SAS controller, known as ARC-8300, which uses the Intel® IOP342 I/O processor with two Intel XScale cores. The two-core configuration processor allows storage systems to further improve system performance by running the RAID stack on one core while processing iSCSI protocol on the other core.

The Areca ARC-1280 RAID HBA is a low-cost, high-performance solution for customers seeking the means to upgrade their RAID systems to match the demands of today's storage solutions. Several features make the Areca cards stand out, including:

- Highest level of sustained throughput. At the time of this writing, only the Areca ARC-1280 is believed to reach 776 MB/sec sustained throughput.^f
- Complete OS driver support to meet the demands of any customer.
- Common, stable RAID kernel, allowing customers to leverage previous Areca development.
- RJ45 (Ethernet) port for out of band support, enabling customers to provide remote management of their RAID solution, without a driver.

- Complete product line meets a variety of customer demands, supporting devices with 12, 16 and 24 ports, PCI Express interfaces, and a single and two-processor HBA architecture.
- LCD module support, enabling the administrator to discover any system issue and set any RAID function from an LCD module, so that customers don't need to be at the client system in order to set the RAID system.
- Hardware-based RAID, including RAID level 6, for disk failure/error protection without sacrificing system performance.

Big Leaps in Sustained Throughput

These performance gains are nothing short of huge. Consider, for example, how 776MB/sec sustained throughput is more than four times that of the RAID 6 performance achieved by previous Areca HBAs, and nearly 10 times greater than traditional desktop Read/Write performance.^f

The Areca HBAs are believed to be the only available RAID 6 cards that can sustain such massive throughput. And competitive solutions may well be months away. This is because Areca signed up as a beta customer during development of the new Intel IOP341/342 I/O processors. This process created a win-win situation for both companies. As a beta customer, Areca was able to provide early validation for the root complex mode for PCI Express—a step that Intel had planned for later in the validation process. In return, Areca was able to reach the marketplace early with their ARC 1280 - PCIe to SATA II and Fibre to SAS RAID HBA products.

Why Intel?

Areca found a lot of benefit in the fact that the Intel IOP341 and IOP342 I/O processors use the same programming instruction set as previous Intel I/O processors. This enabled Areca to take advantage of the field-proven firmware, drivers and utilities from their earlier HBAs as they worked with the new Intel IOP341 and IOP342 I/O processors. Wu summarizes the benefit this way: "Intel's emphasis on architectural commonality in their IOPs allows Areca developers to capitalize on their existing code base."

Another key advantage of using Intel: "Intel has the RAID 6 function built into the chip, which really strengthens the performance of our design," explains Wu. "This gives Areca the advantage of reduced engineering and development costs. By having the new RAID 6 function integrated in hardware, Areca cuts down on the time and effort needed to integrate multiple parts. This feature also saves on component costs by eliminating the need for separate products."

Areca also finds a lot of advantage in working with Intel's marketing and engineering teams. Wu explains: "Intel has a very strong marketing and promotional effort in the global marketplace, which we can tap into as we present our solution to our customers."

About the ARECA ARC-1280 HBAs

The Areca ARC-1280 RAID HBAs achieve higher performance levels from the new Intel® IOP341 I/O processor, a new DDR memory architecture (DDR2-533) and a high-performance PCI Express* bus. With hardware-accelerated RAID, the ARC-1280 can also implement greater fault tolerance by delivering the dual-parity scheme in RAID 6. Areca's internal tests show that the ARC-1280 HBA can concurrently compute two parity blocks and get sustained throughput of 776 MB/sec RAID 6 Reads performance.^f

The ARC-1280 RAID HBAs can also provide RAID levels 0, 1, 10, 3, 5, 6 or JBOD for maximum configuration flexibility. Its high data availability and protection derives from the following capabilities: online RAID capacity expansion, array roaming, online RAID level/stripe size migration, global online spare, automatic drive failure detection, automatic failed drive rebuilding, disk hot-swap, online background rebuilding, instant availability/ background initialization, auto reassign sector and battery backup and redundant flash image. Greater than 2 TB support allows for very large volume set application in 64-bit environment such as data-mining and managing large databases.

The SATA II RAID controllers support broad operating system including Windows* Server 2003, Windows XP, Windows 2000, Linux* (Open Source), FreeBSD* (Open Source), Solaris*, Mac* and other operating systems, along with key system monitoring features such as I2C& SGPIO enclosure management and SNMP function. The controller firmware contains a Web browser-based RAID manager, SMTP manager and SNMP agent which can be accessed via the on-controller Ethernet port with no agent software required.

"We chose Intel I/O processors, because their overall performance and design efficiency enable Areca to construct a cost-effective, high-performance, full-featured RAID 6 system in one integrated solution."

Conclusion

The Intel IOP341 and IOP342 I/O processors are just two of many new Intel chips that are raising the bar in storage performance. With a long roadmap and an established ecosystem of third-party component developers, OEMs can find Intel technologies powering many of the leading solutions available today. Consider the storage industry and Areca's breakthrough new RAID HBAs, and imagine how you can apply such performance in your own solution.

Important features of the Intel® IOP341 and IOP342 I/O Processors

The Intel® IOP341 I/O Processor and Intel® IOP342 I/O Processor introduce a new level of storage power efficiency, performance, flexibility, and data protection. By offering efficient I/O processor performance with the protection and reliability of RAID, these processors enable storage solutions that scale from entry level to the enterprise. In addition, the open, flexible architecture and power-efficiencies of the single chip design present a multitude of potential product designs to create customizable, enterprise-class storage solutions.

Both the Intel® IOP341 I/O Processor and IOP342 I/O Processor offer hardware-embedded RAID acceleration, including enhanced hardware acceleration for the RAID 6 feature set. By offloading RAID 6 calculations from the host CPU, overall system performance is pushed beyond the capabilities of previous-generation hardware. In addition to accelerated RAID, Intel® Block Protection Technology provides an extra layer of data protection, keeping critical storage systems safe and reliable.

The IOP342 divides the load between the two processors, ideal for situations that require a dedicated processor for separate applications or split functionality. This ability enables users to optimize and tailor different types of solutions for maximum performance. For example, RAID calculations or near real-time functionality can be dedicated to one processor, leaving the second processor to handle computing functions that have different performance requirements such as a user interface. Distributed processing of independent tasks greatly reduces the time and power required of each processor, and customizes solutions for maximum processor utilization.

The power-efficient, flexible design of the Intel® IOP341 I/O Processor and IOP342 I/O Processor supports both external storage and embedded technology products. As proven by the availability of the two new Areca ARC-1280 RAID HBAs, the open architecture of the Intel I/O processors supports many different controllers, including SAS/SATA or Fibre Channel devices. When combined with either PCI Express* or PCI-X* controllers or connectivity devices, external storage solution architects can design a single base board that scales from entry level to enterprise level solutions.

For more information:

www.areca.com.tw

http://developer.intel.com/design/io/iop341_42.htm

www.intel.com/go/storage

<http://tweakers.net/benchdb/testcombo/1038>



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^fAll performance data is based on internal Areca tests. Additional information about the performance characteristics of Areca HBAs may be available on the Areca Web site, www.areca.com.tw or by contacting Areca directly.

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