Product Brief
**Intel® IOP348 I/O Processor
Storage Processing**

Intel® IOP348 I/O Processor featuring Intel XScale® technology

High-performance I/O processor and flexible SAS/SATA I/O controller on a single chip
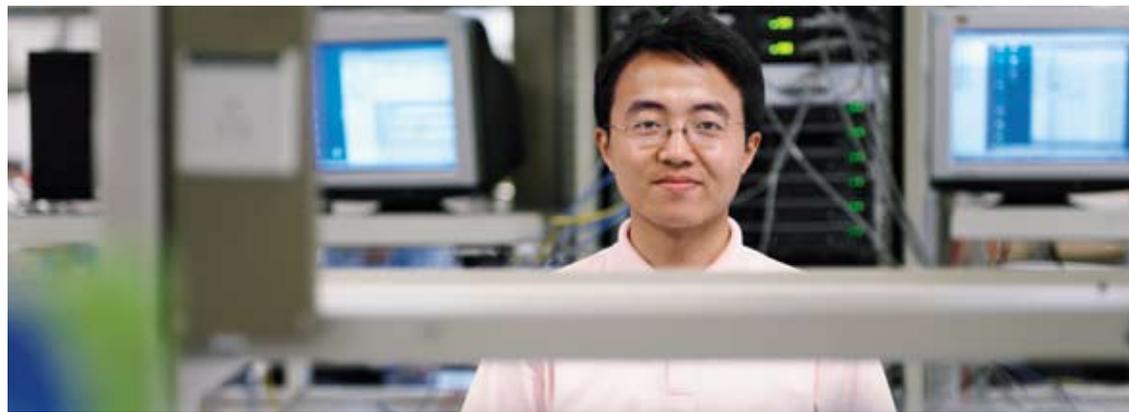
The Next Generation of Power Efficiency, Performance, Flexibility, and Data Protection

With an integrated power-efficient, high-performance Intel XScale® processor, the Intel® IOP348 I/O Processor is a storage system-on-a-chip that delivers enterprise-class SAS and IOP RAID with significant flexibility and interoperability. The IOP348 integrates an I/O processor with a SAS/SATA I/O controller, combining RAID and SAS technologies to deliver a new level of storage performance for internal and external storage products. As part of a flexible family of storage products, the IOP348 brings SAS RAID into the mainstream, enabling businesses of all sizes to benefit from its protection, performance, and power-efficiency.

Enterprise-Class SAS Made Simple

As parallel interfaces are replaced with higher performance serial interfaces, SAS and SATA are fast becoming leading technologies. SAS technology delivers the powerful combination of SCSI reliability with the speed and ease-of-use of serial communication, resulting in 3 Gb/s maximum throughput for enterprise storage systems. The Intel® IOP348 I/O Processor deliver enterprise-class SAS at a low solution cost and small footprint. The IOP348 is at home in a wide range of solution topologies because of its extensive support for SAS and SATA drives, both direct-attached and through expander. Businesses can now realize the potential of SAS drives while consolidating existing SATA equipment, dramatically improving the flexibility and extensibility of their storage solutions, whether integrated into larger designs or smaller discrete form factors.

Optimized IOP-based RAID

RAID technology is crucial for keeping today's business data completely protected and constantly accessible. The complex calculations required when running RAID array software in a host driver place a large load on the server CPU. The Intel® IOP348 I/O Processor offers hardware RAID acceleration, including enhanced hardware acceleration for RAID 6. By offloading RAID 6 calculations from the host CPU, overall system performance is pushed beyond the capabilities of previous-generation hardware. Byte parity on the data bus and support for ECC memory provide extra layers of data protection, keeping critical storage systems safe and reliable.

Unparalleled Design Flexibility

The Intel® IOP348 I/O Processor is part of a larger family of products that are pin compatible, driver compatible and interoperable. This gives developers maximum product design flexibility and provides a wide range of disk control and RAID options. Designers can take advantage of both PCI-Express* and PCI-X* interfaces, increasing end user interface configuration options and accommodating a variety of product solutions. The single chip, space-saving design lowers total solution cost, board real estate usage, and thermal requirements over Intel's previous generation I/O processor. Pin compatibility across the family of products significantly increases an OEM's ability to customize their own solutions using a single board design, allowing the widest possible range of disk control and RAID options. Finally, supporting both SAS and SATA storage devices delivers the flexibility to customize the performance, cost, and reliability of a storage solution.

Pin compatibility, driver compatibility, and product characteristics extend beyond Intel products to the Emulex Fibre Channel I/O processors.* The Fibre Channel-based Emulex* IOCP 504 I/O Processor* and SAS/Fibre Channel multi-protocol Emulex IOP 502M I/O Processor* can easily be incorporated with a few design changes from the IOP348 to enable multi-protocol solutions with a minimum of engineering effort. Engineers can focus on the signaling characteristics of 4 Gb/s Fibre Channel while knowing that other aspects of the design such as their software stacks, device drivers (based on Emulex's SLI* technology), memory, peripherals, and host bus interfaces will all be equivalent. These commonalities make possible a broad product line with minimal engineering work—a truly multi-protocol solution.

Features and Applications
Deliver Maximum Value

The Intel® IOP348 I/O Processor is well suited for local direct-attached and external storage products. Available in multiple speeds, the features and performance scale between uni-processor (UP), dual-processor (DP), and multi-processor (MP) motherboards, offering consistent storage qualities for an entire product line. The form factor is well suited for use in add-in host-bus adapter cards, allowing existing systems to be easily upgraded with a high-performance, cost-effective storage solution and providing enterprise-class RAID offload performance at lower solution costs.

SAN or NAS host processor needs are well met with the Intel® IOP348 I/O Processor serving as SAS initiator with integrated hardware accelerators that boost iSCSI performance. In addition, the IOP348 is field upgradeable via plug-in upgrades (either hardware- or software-based) which give end users the option to upgrade from simpler RAID 0/1 algorithms to higher-functionality algorithms such as RAID 5 or RAID 6. Upgrades can be used to generate additional revenue and to offer product variety from a small number of base designs.

In RAID Bunch of Disks (RBOD) usage models, the Intel® IOP348 I/O Processor supports devices as initiator where the use of wide-port SAS connectivity enables high-bandwidth connections to remote RBOD devices.

Product Highlights

> High-performance RAID system-on-a-chip with an integrated 3 Gb/s SAS/SATA II controller

> Fourth generation Intel XScale® Processor with core speeds up to 1200 MHz and 512 KB L2 cache

> 8 port, 3 Gb/s SAS/SATA engine supporting industry standard SSP, STP, SMP, and direct attached SATA

> Hardware RAID 6 acceleration with near RAID 5 performance

> Pin compatibility with Intel® IOP341 I/O Processor, Intel® IOP342 I/O Processor, Intel® IOC340 I/O Controller, Emulex IOP 504 I/O Processor,* Emulex IOP 502M I/O Processor,* and Emulex IOC 504 I/O Controller*

> Emulex's Service Level Interface (SLI*) technology providing a driver compatible API

> Multi-ported 400/533 MHz DDR2 memory controller supporting up to 4 GB of 64-bit ECC protected memory

> Three application DMA units with XOR, RAID 6 P+Q, CRC32C

> Dual- or single-interface PCI-X* and PCI-Express* host bus interface options

> Dual 128-bit/400 MHz internal buses, providing over 12 GB/s internal bandwidth
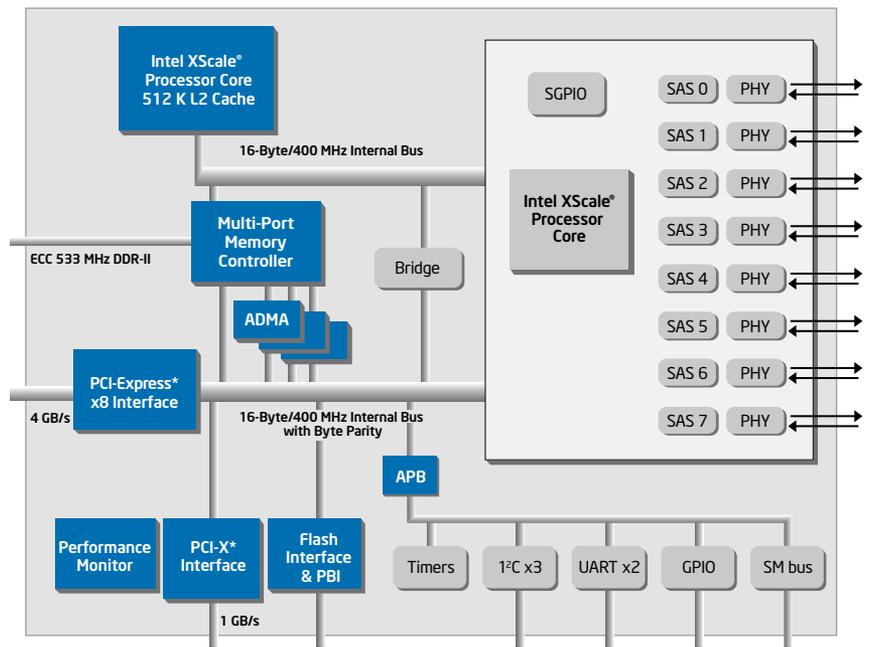
Customer Reference Boards (CRBs)

Customer Reference Boards (CRB) are available in both Host Bus Adapter (HBA) and Micro-ATX board formats. Each has on-board GbE, Dual UARTs and JTAG connections to enable flash programming and debug access. The HBA is a PCI-Express plug in form factor with one PCI-X slot, and the Micro-ATX style board has one PCI-Express slot and one PCI-X slot. Both the HBA and Micro-ATX form factors are shipped with a 1200 MHz IOP348, 256 MBs DDR2-533 DIMM, and SAS cables to support eight SAS drives.

For more information about the boards, supported operating systems, or software development tools, please reference the following product codes.

IQ81348SC.Kit: PCI-Express Form Factor CRB
IQ81348MC.Kit: ATX Form Factor CRB

Features	Benefits
Intel XScale® Processor	Up to 1.2 GHz, 512 KB 8-way L2 cache meets today's storage demands and guarantees compatibility with previous generations.
SAS/SATA II Engine	SSP, STP, SMP, and direct attached SATA support for flexible storage options enabling high-performance hardware at a lower cost.
Multi-ported Memory Controller	Supports up to 4 GB of 64-bit DDR2 memory and direct core-to-memory access dramatically increases core-to-memory performance.
Three Application DMA Units	XOR, P+Q, Scatter/Gather and CRC32C – Storage-specific integration in hardware improves performance and reduces CPU overhead.
PCI-X* and PCI-Express* Options	Dual- or single-interface delivers flexibility and performance for increased system concurrency. PCI-Express* also supports root bridge and PCI-X*.
Bus Mastering and Root Complex	Central resources and root complex are available on PCI-X* and PCI-Express* respectively, to provide flexibility for direct-attached and external storage applications.
Dual Internal Buses	Dual 128-bit/400 MHz internal buses , providing over 12 GB/s internal bandwidth.

Intel® I/O Processor Comparison

	Intel® IOP348 I/O Processor	Intel® IOP341/342 I/O Processor	Intel® IOC340 I/O Controller	Intel® IOP333 I/O Processor
Intel XScale® Technology Application Cores	1	1/2	0	1
Core Speed	667/800/1200 MHz	800/1200 MHz	800/1200 MHz	500/667/800 MHz
RAID 5/6 Offload Solution Chip Count	1	2	2	2
SAS/SATA II Ports	8	0	8	0
Package Size	37.5 mm x 37.5 mm FCBGA5	37.5 mm x 37.5 mm FCBGA5	37.5 mm x 37.5 mm FCBGA5	37.5 mm x 37.5 mm FCBGA3
Integrated Host Bus Interfaces	PCI-Express*, PCI-X* or both concurrently	Concurrent PCI-Express and PCI-X	PCI-Express or PCI-X	PCI-Express to PCI-X Bridge
Memory Controller	Multi-ported DDR2 400/533 MHz with ECC	Multi-ported DDR2 400/533 MHz with ECC	n/a	Dual-ported DDR 333 MHz/DDR2 400 MHz
Internal Memory	n/a	1 MB SRAM	n/a	n/a
Max Memory	4 GB	4 GB	n/a	2 GB (DDR 333) 1 GB (DDR2 400)
Internal Bus	128-bit, 400 MHz (up to 6.4 GB/s) Dual Bus. Byte parity on data bus	128-bit, 400 MHz (up to 6.4 GB/s) Dual Bus. Byte parity on data bus	128-bit, 400 MHz (up to 6.4 GB/s) Dual Bus. Byte parity on data bus	333 MHz (up to 2.7 GB/s) Bus
Local Bus Width	16 Bits (66 MHz)	16 Bits (66 MHz)	16 Bits (66 MHz)	8/16 Bits (66 MHz)
DMA Buffer Size	4096 Bytes	4096 Bytes	4096 Bytes	1024 Bytes
ATU Buffer Size	4096 Bytes	4096 Bytes	4096 Bytes	4096 Bytes
I²C Bus Interface Unit	3	3	0	2 Serial Units
Hardware-based Application Accelerators	XOR, P+Q, CRC32C	XOR, P+Q, CRC32C	n/a	XOR, P+Q, CRC32C
UART	2 (1 Available for the IOP)	2	0	(2) 4-Pin (16550)
GPIO	16 GPIO 2 SGPIO units capable of up to 8 devices on the target end	16 GPIO	8 GPIO 2 SGPIO units capable of up to 8 devices on the target end	8 GPIO
External Interrupt Pins	16 + 1 HPI	16 + 1 HPI	n/a	16 + 1 HPI

Conclusion

The Intel® IOP348 I/O Processor delivers the next generation of storage power efficiency, performance, flexibility, and protection. By combining the protection and reliability of IOP-based RAID with the performance of SAS at a lower solution cost, the IOP348 enables SAS to enter the mainstream. 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. As part of a flexible family of products, the IOP348 enables businesses of all sizes to benefit from the next evolution of storage technology.