

LightningBolt



VME Multiprocessor Board/Systems



- Best Price/Performance of High Performance Embedded Computers
 - 38.4 GFLOPS per 6U VME Slot
- Scalable Systems: Proven and Reliable
 - Up to 64 processors per system
 - 2 GB SDRAM per compute module
- Integrated Lifecycle Support
 - Proven history of software portability
- Deployment Ready
 - Field tested advanced packaging

For over 25 years SKY Computers has been building some of the world's fastest and most reliable embedded computers. SKY supplies more than half of the computers for explosive detection systems that scan luggage at airports across the United States. SKY also builds the industry's most powerful commercial computer systems and has deployed systems that have successfully met the demanding requirements of ruggedization for airborne radar applications.

LightningBolt™ is a new generation of embedded computers that deliver unprecedented levels of scalability, reliability and price/performance for demanding applications. Field-tested packaging and connector technologies make the new 6U LightningBolt VME boards deployment-ready for harsh environments, leveraging advanced stiffening technologies to increase vibration tolerance. LightningBolt is aggressively priced well below currently available high performance embedded computers.

LightningBolt uses the 1.2 GHz PowerPC MPC7448 microprocessor and the ANSI/VITA standard SKYchannel interconnect fabric, delivering optimal computing and I/O performance. The advanced SKYvec® software development environment provides tools that simplify complex multiprocessor programming. The 6U LightningBolt is configured with one compute module of four MPC7448s and one optional I/O module.

The new LightningBolt embedded computers are 100 percent compatible with SKY's previous SKYbolt® family of products. Customers can easily upgrade to LightningBolt without re-writing their applications.

LightningBolt: Delivering Optimal Compute and I/O Performance

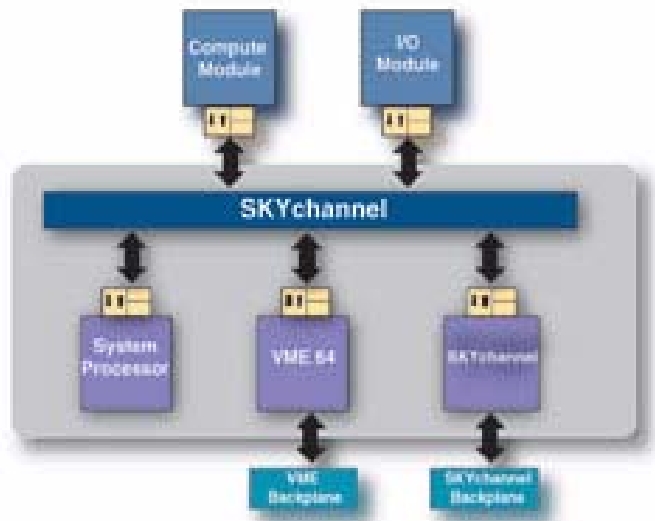
The 6U LightningBolt board provides all the resources required to obtain optimal performance from SKY's compute and I/O modules. It is configured with one compute module of four MPC7448 processors.

LightningBolt Features

- 1 MB of L2 Cache per processor (built-in)
- 1.6 GB/sec memory bandwidth per processor
- 1.6 GB/sec inter-processor communication
- High performance with superior reliability
- 320 MB/sec SKYchannel
- Software standards: VS IPL, MPI
- SKYvec compilers automatically optimize, stripmine, and vectorize
- Standard Math Library automatically calls hand-coded vector and low-level functions
- All hardware interfaces are open standards; VME64, SKYchannel, and FPDP

Data is transferred throughout the LightningBolt over the SKYchannel Packet Bus at 320 MB/sec. Data moves transparently through the SKYchannel P2 interface to other boards in a SKYchannel chassis. System control is handled by the System Processor, which performs I/O and operating system tasks that would otherwise burden the compute processors. A full VME64 interface provides communication to the host and other off-board communication. The application runs on the processors resident on the compute module. Front-panel I/O expansion modules may be added to the LightningBolt for maximum I/O performance.

LightningBolt Architecture



System Processor: Offloading System-Level Functions

The LightningBolt employs a System Processor (SP) to off-load system-level functions from the compute processors. At its core is an Intel i960HD™ super-scalar processor. SKY adds 2 MB SRAM used as zero-wait-state RAM and 16 MB Flash RAM for non-volatile storage of configurable boot code. The large flash memory of the SP provides a Fast Boot capability for the LightningBolt Compute Module which results in 10 second Fast Boot for start up and initialization.

On power-up, the software monitor, kernel, and application are loaded into the working memory of the SP and the compute modules. Because the SKY boards all boot in parallel, the SKY fast boot capability allows an entire 16-board, 64-processor system to start a typical SAR application in 10 seconds instead of the up to 10 minutes for systems without parallel boot capability. This is key in real-time mission-critical applications, where the length of time in the start or re-start of a system can mean missing a potential threat or target. It also saves time in development environments which normally require multiple boots while debugging.

LightningBolt Compute Module: Maximizing Performance

The LightningBolt compute module capitalizes on the AltiVec technology-based 1.2 GHz MPC7448 PowerPCs by supporting high-speed processing with high-speed memory and communication. The LightningBolt compute module uses four MPC7448 PowerPC processors to provide up to 38.4 GFLOPS of performance. Each processor has its own local bank of 512 MB of SDRAM that is accessed over the processor's 200 MHz local memory bus at 1.6 GB/sec. The memory of other processors on the compute module can also be accessed over the 1.6 GB/sec local bus. Memory on other compute modules is accessible through the 320 MB/sec SKYchannel interface.

The processors are directly connected to a 64-bit SKYchannel motherboard interface. A DMA engine in the SKYchannel interface enables computing to occur concurrently with the transfer of data anywhere in the 16 Terabyte memorymapped SKYchannel address space. The application developer can choose between memory mapped or advanced DMA access to shared memory with efficient SKYchannel access.

The LightningBolt Compute Module has been designed to be deployment-ready and provides unsurpassed reliability for deployable environments. In combination with a new heat sink for the PowerPCs, the LightningBolt boards are battle-tested.

Compute Module Features

- Four MPC7448s provide 38.4 GFLOPS per module
- 512 MB SDRAM per processor
- 200 MHz local memory bus
- 1.6 GB/sec local bus
- Latest technologies provide high temperature tolerances
- 1 MB L2 cache per processor (built-in)



SKYchannel Packet Bus: Increasing System Bandwidth

SKYchannel Features

- 64-bit Packet Bus transfer data at 320 MB/sec
- Split Transaction design uses FIFOs and DMA capability at each interface to maximize throughput and minimize blocking on the bus
- Global addressing simplifies programming by addressing memory from any interface
- Modular interface makes heterogeneous processing easy and ensures a future migration path

SKYchannel Backplane

- Connects to boards and expansion slots
- Five independent SKYchannel buses at 320 MB/sec for a total of 1600 MB/sec
- Attaches to the VME P2 backplane

At the heart of the LightningBolt motherboards is the 64-bit ANSI/VITA standard SKYchannel Packet Bus. SKYchannel is the on-board communication path connecting the VME64 interface, the SKYrider parallel I/O, the System Processor, the compute modules, and high speed communication between LightningBolt boards. The 320 MB/sec bandwidth coupled with SKY's crossbar architecture provides for multiple, simultaneous operations increasing available system bandwidth.

SKYchannel's 44-bit address field delivers increased functionality and ensures ease of use. The large address field provides a 16 terabyte linear address space that can be used by any device interface to directly access any address in the system with simple loads and stores. This global addressing simplifies programming and enables data to be transferred easily between processors. The packet switched technology used by SKYchannel reduces transfer latency and blocking by using high-speed bidirectional FIFOs combined with local node DMA engines and packet controllers at every SKYchannel interface. All transfers to FIFOs are zero-wait-state writes from source to destination, providing a data transfer rate of 320 MB/sec. The asynchronous nature of these transfers provides the foundation for performance upgrades.

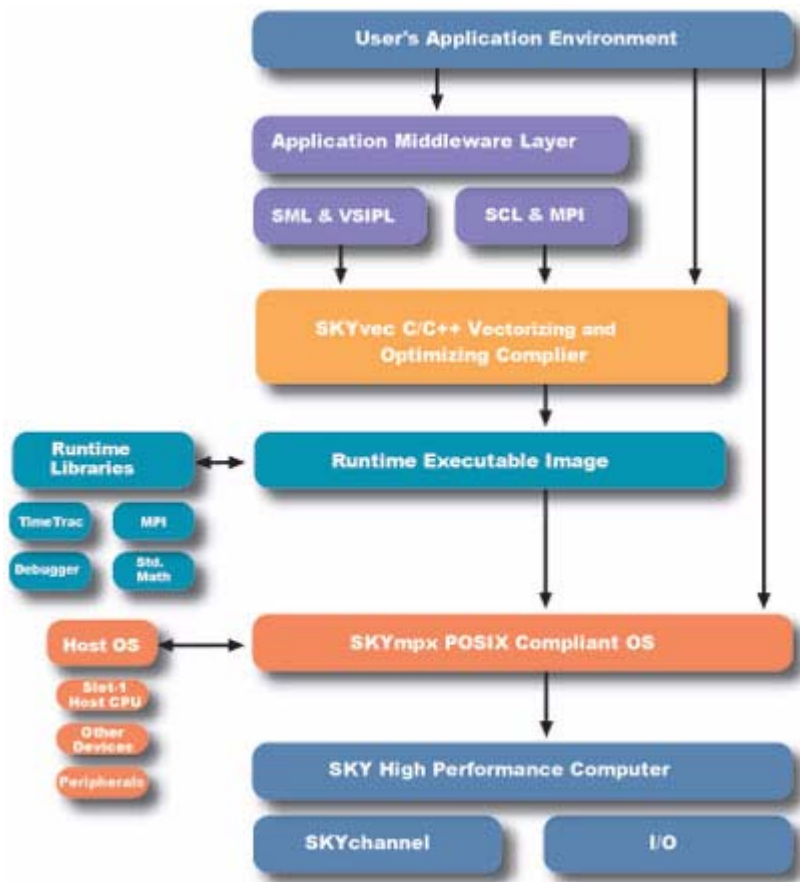
SKYvec: Accelerating Software Development

The SKYvec software development tools simplify code development for large multiprocessor systems by automating many of the processes that otherwise would have to be designed or managed by the application developer. SKYvec eliminates the need for complex and costly software migration and extensive training classes by making development easier than ever before. Depending upon the complexity of the application, the software development effort can be reduced 30-50% using the standard SKYvec API. As with past technology insertions, LightningBolt only requires a simple recompile and run, virtually eliminating recoding efforts. Imagine the impact on software efforts across the lifecycle of your application and the financial payback that will be realized.

The SKYvec Software Development Environment is a robust toolkit including OS, compilers, vector/image processing and math libraries, and unique facilities such as event analyzers and multiprocessor debuggers that provide high performance, portability and ease of use. Building on industry standards, SKY has pioneered the use of intelligent compilers and libraries that stripmine and vectorize application code to automatically optimize performance.

SKYvec chains across vector functions, optimizing between functions, not just inside of them. This applies to hand-vectorized code as well as to scalar C code, optimizing and vectorizing globally, not just locally for each function. The result is that the application code takes maximum advantage of the hardware architecture and runs at the highest level of efficiency and performance available with little or no hand coding.

SKY Computers has reduced the learning curve and the time to develop application code by simplifying and automating low-level optimizations and tasks. SKYvec provides a suite of development tools that simplify the programming effort without compromising performance. Sophisticated porting and development tools virtually eliminate complex tasks and training. LightningBolt systems make full use of SKYvec including intelligent compiler technology that automatically optimizes and vectorizes application code. The SKY Standard Math Library contains hundreds of math, image, and signal processing functions. SKY/VSIPL simplifies multiprocessor development and ensures portability across platforms. The TimeTrac™ Event Analyzer provides insight into the dynamic interactions between processors for multiprocessor or multicore optimization and debugging. With full MPI support, the complexity of multiprocessor implementation is reduced. SKY provides portability while simplifying the complexities of creating high performance multiprocessor code.



SKYvec tools make the programming challenge easier. Standards-based, flexible, and scalable facilities result in faster application development and validation. A sophisticated event analyzer enables multi-process performance monitoring and analysis.

Standard Math, and Vector Signal and Image Processing (VSIPL) Libraries provide easy-to-use, high-level vector functions that are architecture independent. The full implementation of industry standards, innovative tools, and guaranteed portability are the result of SKY's pioneering excellence in software.

Complete Application Solutions

SKY delivers fully integrated subsystems built from commercial off-the-shelf components, but designed specifically for your application. SKY configures the rugged chassis, CPU boards, standard interconnect fabrics, high performance multiprocessor boards, compilers, middleware, and software development tools, as well as the storage and peripherals, as the total solution configured for your application - complete, tested, and ready to run.



SKYrider: Enabling High-Speed Data I/O

SKYrider is a 32-bit parallel interface I/O module that enables high-speed data I/O directly through the SKYchannel bus. SKYrider is an option on the LightningBolt. This open system interface provides an easy-to-implement gateway into the LightningBolt from other COTS products or customer-supplied devices. SKYrider is 100% compatible with the industry standard Front Panel Data Port (FPDP). When receiving data, the SKYrider interface syncs to the clock rate of the data source, up to 40 MHz. When transmitting data, the speed of the SKYrider interface is switch selectable at 20 or 40 MHz. For multicast applications, SKYrider can drive multiple receiving devices. SKYrider is configurable for either input or output. It has a direct connection to the SKYchannel bus and includes a 128 KB data FIFO interface. It is controlled as a peripheral device by the System Processor so that the compute processor does not stop computing to control the I/O. SKYrider is programmed in the application running on the compute processors.

VME 64 Interface

The LightningBolt includes a fully featured VME64 Master/Slave interface. Data transfers using multiplexed block mode transfers (MBLT) provide high performance communication with other VME boards. The fully programmable master/slave interface supports Read-Modify-Write (RMW) cycles, three programmable release methods, requester on all levels, interrupter on all levels, and VME Retry. A special communication buffer RAM enhances performance of VMEbus RWM cycles.

Technical Support and Warranty Programs

SKY's commitment to quality begins with the standard one year hardware warranty. Throughout your development and deployment, SKY's experienced technical support engineers follow up with the support you need when you need it.

LightningBolt Specifications

System Processor	Intel i960HD, 40 MHz
External Memory	2 MB SRAM 16 MB Flash RMA

SKYchannel Interface

Specification	ANSI/VITA 10-2002
Location	Motherboard system bus and P2 backplane interface
Data Size	64 bits data per word; up to 256 data words per packet
Throughput	320 MB/sec
Addressing	44-bit addressing, 16 Terabyte address space

VME64 Interface

Specification	ANSI/VITA 1-1994
Interface Capabilities	A16 and A24 (master only), A32, D8, D16, D32 (single), D16, D32 (BLT), D64 (MBLT), RMW and VME Retry

Configuration Options

P2 Interface	SKYchannel Backplane
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Environmental Requirements

Temperature	0° to 55° C, operating; -40° to 85° C, non-operating
Humidity	5% - 95%, non-condensing
Air Flow	at least 300 LF/min

Electrical Requirements

DC Voltage	5.0 Volts \pm 5%
Power Consumption	Motherboard, up to 20 Watts Compute Module, up to 45 Watts SKYrider, up to 8 Watts

Physical Dimensions/Weight

Motherboard	6.3" x 9.2", .980 lbs.
Compute Module	6" x 6", .450 lbs.
SKYrider	3" x 6", .185 lbs.

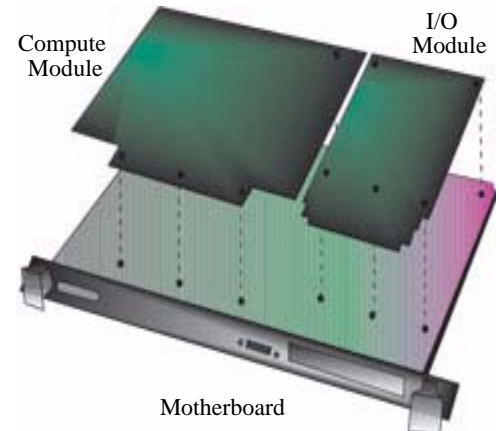
LightningBolt Compute Module Specifications

Performance	38.4 GFLOPS per module (peak)
Processors	4 MPC7448 processors per module
Clock Frequency	1.2 GHz
L1 Cache	32K instruction, 32K data
L2 Cache	1 MB per processor (built-in)
Floating Point Unit	IEEE 754 single and scalar
Fixed Point Units	Dual 32-bit Integer Units
Vector Instructions	Full 128-bit AltiVec implementation, 8-, 16-, 32-bit integer, single precision floating point
Memory	512 MB SDRAM per processor, 64-bits wide @ 200MHz
Module Interface	SKYchannel Packet Bus (ANSI/VITA 10-1995)

SKYrider Specifications

Peak Transfer Rate	160 MB/sec (32-bits @ 40 MHz)
Sustained Receive Rate	156 MB/sec (maximum)
Sustained Transmit Rate	122 MB/sec (maximum)

Specifications subject to change. SKY Computers is a registered trademark of SKY Computers, Inc. LightningBolt is a trademark of SKY Computers, Inc. All other product names are the trademarks of their respective holders. Doc #300-702, Rev 1, 01/2008



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