In-Sun
Computing Surface

meiko

Parallel Processing: Setting New Standards

"Natural barriers limit opportunities to gain another order of magnitude performance from technology alone. Significant future computing performance gains will come from machine organization or architectural features rather than underlying technology. Parallel processing is currently the best hope for such architectural gain."

Dataquest Inc. 1988

Contemporary computer architectures are based upon uniprocessor designs developed many decades ago by John von Neumann. The number of remaining improvements that may be made to the uniprocessor architecture are diminishing as device technologies approach the ultimate barrier: the speed of light. This dictates the maximum speed at which signals may be propagated.

Natural, scientific, engineering and commercial phenomena are inherently parallel. Rarely will you discover problems with intrinsic sequentiality. The application of concurrent processing permits more powerful and accurate modelling of the inherently parallel processes which occur in nature and commerce.

Concurrent processing offers the most cost effective means of achieving maximum absolute computing performance. Meiko exploits this to deliver a solution for today and the future, providing limitless processing, i/o and store capability in a scaleable, parallel architecture.

The Computing Surface does not compete with the barriers imposed by the laws of physics — it simply outnumbers them.

Meiko: Leading the field

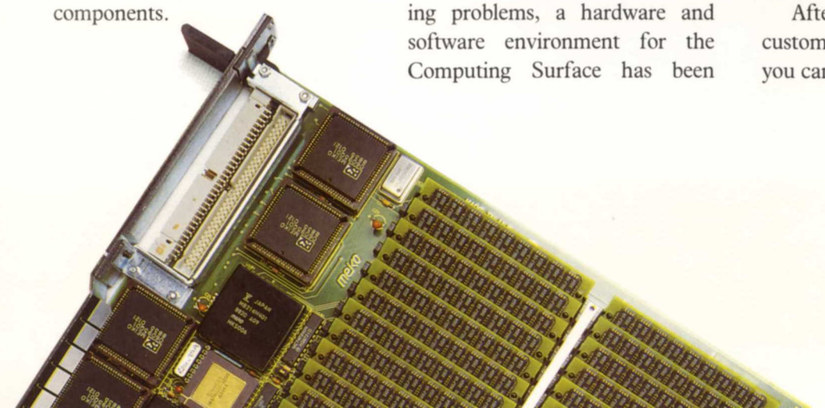
The Meiko founders came together during the creation of the microcomputer division of Inmos. They defined the design approach. They implemented the VLSI CAD tools which embodied that approach. They were responsible for the design and implementation of the Transputer. They were instrumental in setting the standard for parallel processing components.

Meiko was formed in 1985 to construct systems and software which exploit concurrency, and has used the transputer to build a range of products which enable end users to benefit from the application of concurrency.

Through Meiko's insight into the issues associated with the application of a multiprocessor architecture to everyday computing problems, a hardware and software environment for the Computing Surface has been created. This environment provides a level of abstraction, allowing users to develop and run parallel applications without concern for the underlying architecture of the machine.

The customer base of several hundred users spans commercial academic, research and military users across America, Europe and the Pacific Basin.

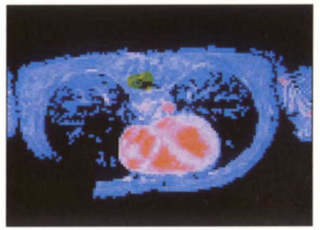
After several years of consistent customer successes, it's clear that you can benefit too.

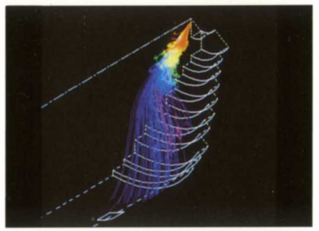


Meiko: Pushing Forward the Frontiers

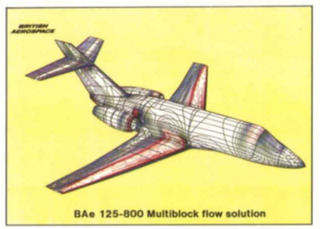
Professionals worldwide are pushing forward the frontiers with Meiko's Computing Surface. They choose Meiko systems because they work, solving hard problems with usability, reliability and excellent cost performance.

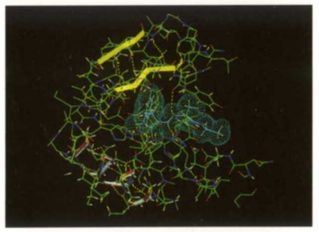
*M*edical physicists use the power, convenience and reliability of the Computing Surface to render vast quantities of computer tomography data, allowing the manipulation and display of three dimensional images in real time.



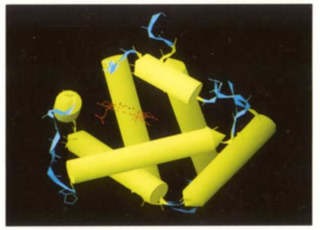


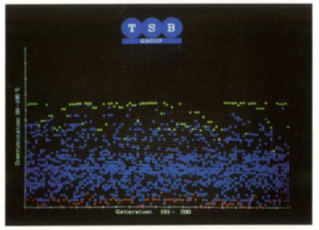
*A*eronautical engineers are using the Computing Surface and computational fluid dynamics, simulating conditions and providing diagnostics to improve understanding of their designs.



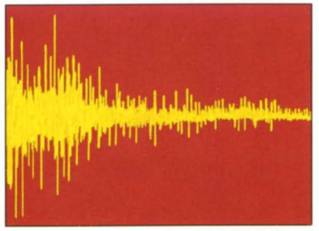


*D*rug designers use Meiko systems for molecular modelling and analysis, shortcircuiting the discovery cycle for new and more effective drug compounds.





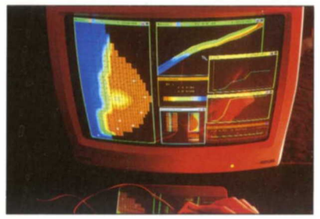
*F*inancial institutions are improving the quality of their decision making by employing new financial modelling techniques only made practicable by the Computing Surface.



*G*overnments are using the Computing Surface for cryptology and signal processing, discerning patterns and features previously undecipherable.

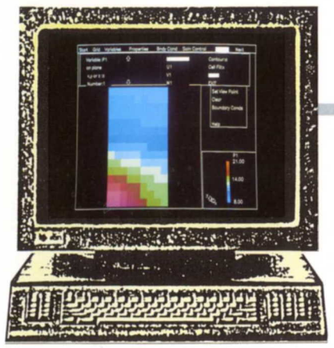
Artist's impression

*B*roadcasting corporations use the Computing Surface as an interactive realtime image computer for in-house rendering, raytracing and animation.

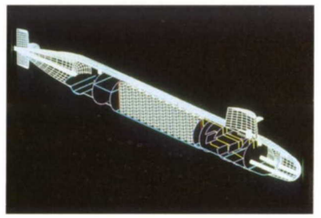


*O*il and Gas corporations are using Meiko systems for the next generation of seismic modelling, and for the modelling of oil and gas reservoirs producing immediate animated visualisations.

*L*eading multinational electronics companies are harnessing the absolute computational power of the Computing Surface to deliver the new standard in video compression techniques.



*G*raphics and animation companies use the Computing Surface as a very fast solid modelling design and production tool, generating photorealistic images for print and animation.



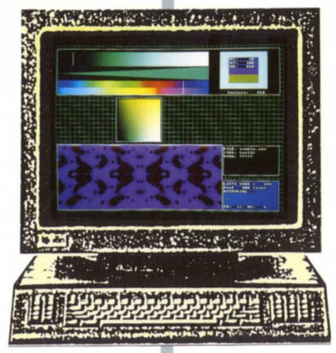
*M*ilitary contractors are vertically integrating the Computing Surface for a diverse range of applications, including battle simulation, electronic counter measures, neural networks and discrete event simulation.

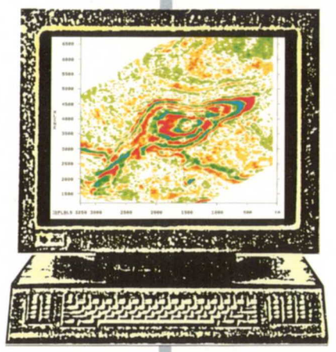
Many barriers to progress can be breached only by high-speed computing.

Military and commercial decision support can necessitate sub-second response. Major engineering and commercial applications executing in minutes rather than hours mean decision making and design processes are accelerated — projects are completed sooner. Applications which can execute in hours rather than days are now feasible.

Meiko systems unleash this processing power to give corporations and research establishments a clear competitive edge.

Open Systems and Networks of Computers





Sun Microsystems masterminded the open systems revolution and created the vendor independent alternative. Heterogeneous computing networks of many vendors' products are now a reality.

Unix The foundation stone of Sun's open systems approach is the UNIX operating system. SunOS combines AT&T System V and 4.3/4.2 BSD to deliver the industry's most acceptable Unix standard.

Networking Central to the Sun open computing philosophy is the Open Network Computing (ONC) environment. ONC makes distributed resources easily accessible by communities of workstations, servers and other computing systems. Included within ONC is the Network File System (NFS), a de facto standard for the transparent access to file structures over the network, even to the file stores of other vendors' computers with different architectures and operating systems. Sun also provides extensive data-communication links over both local and wide area networks with SunLink, thus ensuring Sun users with a smooth integration of their system with all IBM and DEC computers.

Workstations — the importance of Windows An industry-standard windowing environment is as important as the availability of multi-vendor access through networking. Sun's Open Windows gives a consistent, window-based solution which is both natural to use and straightforward to implement. Open Windows consists of three primary components: the OPEN LOOK graphical user interface, the XView toolkit and the X11/NeWS window system.

The Network is the Computer The Sun Microsystems model of distributed computing unifies all the resources on a network, seamlessly presenting the benefits at each workstation. The human interface for programmers and end-users is interactive, mouse driven and graphical. Windows provide the natural means to manage multiple simultaneous tasks executing anywhere on the network.

The In-Sun Computing Surface is fully integrated into the Sun environment. The benefits of high performance parallel processing and multi-processor computing seamlessly delivered to the network community.

Scaleable High Performance Power users in science and commerce with an emerging class of supercomputer application have made a cost/benefit trade-off. They are improving their decision making capability by investing in advanced computational modelling techniques.

The In-Sun Computing Surface is a cost effective delivery vehicle, interactive application accelerator or multi-user supercomputing resource. Its scaleable architecture provides a machine that cannot be outgrown.

Massive Throughput Networked Sun user communities with high volume sequential program workloads are CPU bound. These tasks may be offloaded transparently to the multi-tasking multi-processor In-Sun Computing Surface. System throughput is increased and job turnaround time is reduced, batch queues are shorter, results return sooner.

Industry Standard Software Parallel solution developers are making a major investment. They need a high productivity environment to construct portable parallel applications. This means standard languages, standard debuggers, source code management and a machine independent parallel model. SunPro and CS Tools combine to form a cross development toolset for application prototyping within the workstation.

The In-Sun Computing Surface provides a network available multi-user test bed with familiar dbxtool symbolic debugging for runtime proving of completed applications. The existing skill base familiar with this industry standard environment gains maximum productivity in parallel application development with the minimum investment of effort.

The Meiko Portable Parallelism Environment

The move to parallel processing presents many choices. The distributed memory message passing model is the most exciting because of its formal basis and its inifinite expandability. Already there are numerous machines available.

A unifying abstraction is required which delivers the benefits of the underlying hardware facilities — both those available now, and those which will become available in the future.

For a parallel applications developer, the major investment should be in delivering ***application insight.*** Structuring to exploit parallelism needs to be painless, insulated from specific hardware realisations.

CS Tools is a parallel development paradigm for exploiting a generic message passing multiprocessor model. The well defined functional interfaces provide a straightforward means for applications portability and machine future-proofing. Applications code is written in standard high level languages.

This insulation from details of hardware is provided by the CS Tools runtime environment. It is put in place, as and where necessary, by the CS Build utility set.

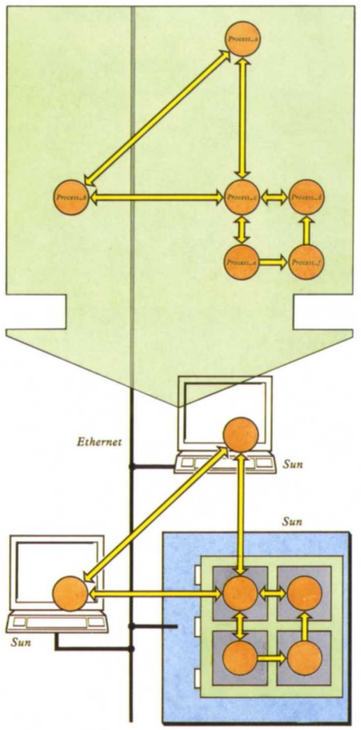
Parallel applications can be run on a single Sun workstation, a network of Sun workstations, a Computing Surface, or any combination of these. Embedded systems and third party machines are also supported.

Future Meiko products will preserve the CS Tools applications interfaces but embody more functionality in hardware.

CS Tools

This is an easy to learn set of tools with a small number of components for the construction of portable parallel applications. These applications are expressed as multiple sequential code threads which cooperate by message passing. CS Tools consists of utilities and a runtime support system.

CS Tools: portable parallel applications are constructed from sequential program threads which co-operate by exchanging information. A unique feature of the CS Tools system is that a single application may be distributed across the Sun network as well as the parallel machine.



The utilities are:

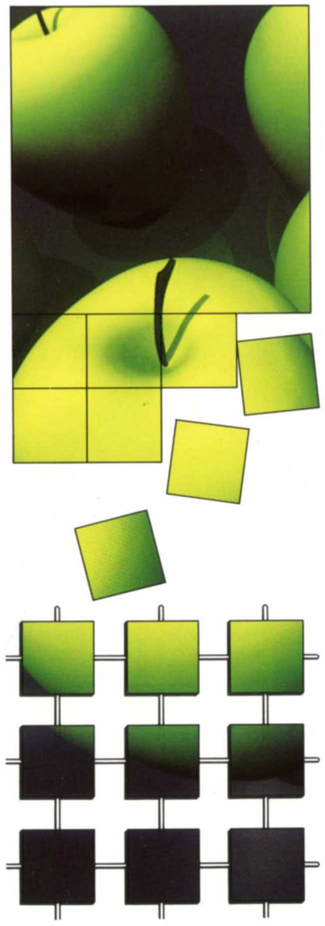
- The standard sequential language compilers.
- The symbolic runtime debuggers.
- CS Build, the parallel applications instantiator.

CS Build is the parallel applications instantiator used for loading the sequential threads onto appropriate processors. It selectively includes RTE and CSN routing capabilities alongside sequential threads as demanded by the application. Because CS Build operates at load time, it enables a parallel application to be re-targeted to different parallel machine configurations with no modification to the application itself. It includes the capability to place one or more sequential threads within the workstation environment in addition to the Computing Surface.

The runtime support system has two major components; the runtime executive (RTE) which handles operating system requests and the computing surface network (CSN) which provides a virtual connectivity mechanism.

RTE provides a scaleable subset of the SunOS UNIX environment to applications threads running within the Computing Surface. These are either serviced locally or make use of remote resources via CSN.

A library of message passing routines provide the programmer's interface to communications facilities. Where direct hardware connection is not possible, the CSN automatically provides through-routing, buffering and multiplexing.

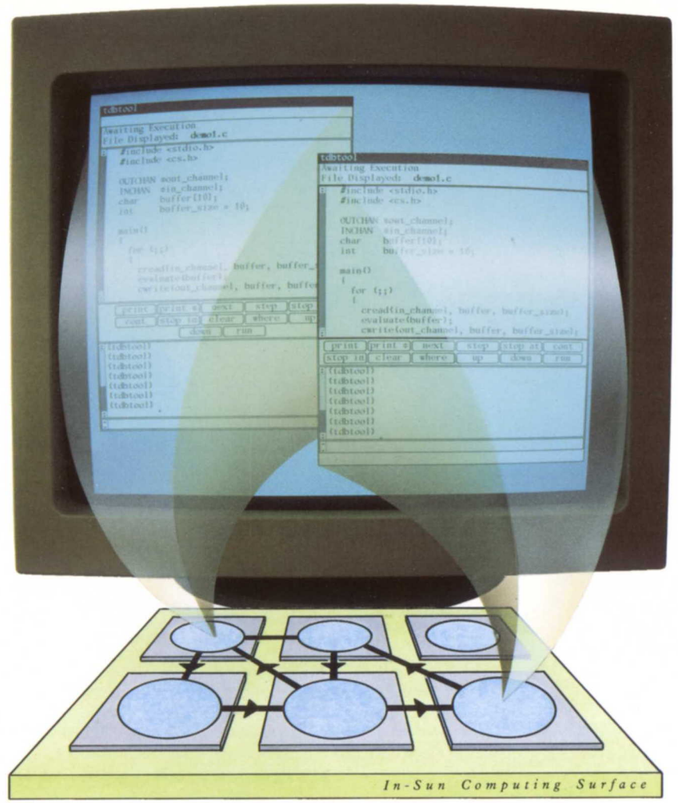


Parallel programming using the CS Tools model: in a typical image generation application the task is split into numerous small tiles and each is allocated to the next free processor.

Standard High Level Language Compilers

Conventional sequential programs or sequential threads of portable parallel applications are written in standard languages, FORTRAN or C, for example. These are supported by cross compilers and symbolic debugging facilities which operate in the workstation environment. The user interface for the symbolic debugger is Sun's dbxtool, providing identical functionality for both target application operation and in-workstation prototyping.

The C cross compiler supports the draft ANSI standard, and complies with the de-facto standard embodied in K&R edition 2. The Fortran 77 cross compiler conforms to ANSI standard x3.9-1978 with the option for industry standard VAX extensions. Conventional SunOS source code control and *make* facilities are used in the management and construction of applications, providing a flying start when porting existing codes.



Debugging a parallel program: A CS Tools application consists of a set of sequential code threads executing on a number of processors. The Meiko **tdbtool** symbolic debugger allows threads to be debugged as if they are sequential programs running locally. In the C source text displayed here, one thread sends information using the **'cwrite'** library function — which is received by another thread executing on another processor which invokes the **'cread'** function.

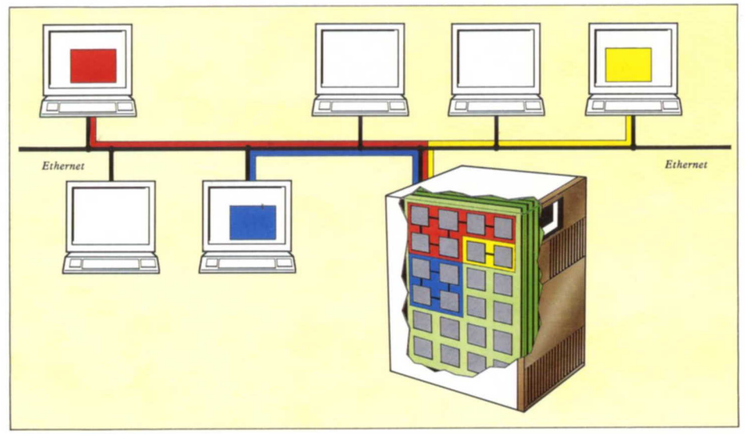
Multi-User access to the Computing Surface

Sun-VCS (Sun Virtual Computing Surface) provides the resource management and physical interface control software. It provides the flexible capabilities of the In-Sun Computing Surface integrated with the SunOS environment.

Sun-VCS presents users with an uncomplicated view of the Computing Surface: A pool of applications processors. As additional processors are added to the system, the size of this pool simply increases. Applications automatically claim processors from this pool, these may be single processors or groups of processors. Sun-VCS transparently reconfigures the hardware establishing the appropriate topologies demanded by parallel applications as they are loaded for execution.

An external Computing Surface may be attached to the In-Sun Computing Surface. Sun VCS manages this seamlessly: the pool of available processors simply becomes larger.

The In-Sun Computing Surface As a Network Resource: Sun-VCS automatically allocates and configures the hardware in response to requests from throughout the network. (The user command line is simple — users need not be concerned how or where the code is executed)

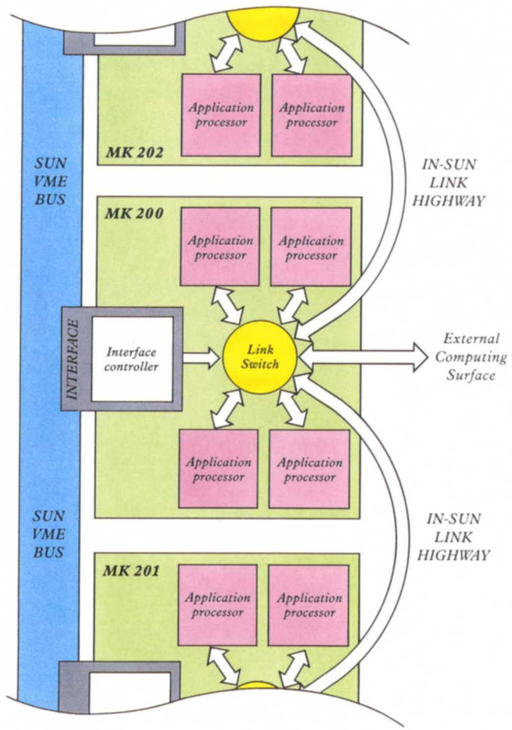


In-Sun Computing Surface Hardware

The Computing Surface is a scaleable, multi-processor distributed memory architecture. Individual processors execute sequential threads of application programs within their own dedicated memory systems. They co-operate when required by exchanging information via high performance inter-processor message links. Embedded microcode schedulers manage task synchonisation while threads co-operate.

Processors are used independently for sequential applications, or in groups for parallel applications. The Computing Surface message link switch allows the optimum network topology to be used for every application. The message link switch, constructed with proprietary VLSI routing chips, enables high speed, low latency message paths to be established between co-operating processors under software control — effectively allowing application software to determine its own parallel machine architecture.

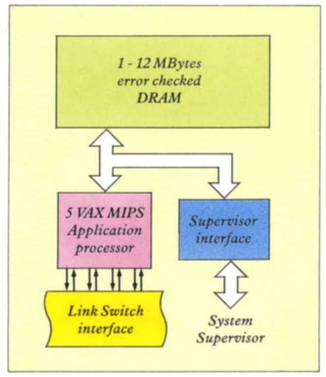
The scalability of the Computing Surface architecture has allowed hundreds of machines to be constructed, ranging in size from a few processors, yielding supermini performance of a few megaflops, to hundreds of processors with gigabytes of distributed random access memory able to sustain supercomputer performance in the gigaflops region.



- The In-Sun Computing Surface provides a range of board level alternatives for ready integration within Sun Workstations and servers. Multiple boards may be combined utilising the expansion slots of these industry standard host machines. Further, unlimited expansion is achieved by attaching Computing Surface modules to the external interfaces of In-Sun boards.
- The individual processors are Inmos T800 Transputers, each delivering 5 VAX MIPS sustained performance. They are purpose built for distributed memory message passing multi-processor construction.
- Transputer message passing links are connected under application software control using Meiko's proprietary low latency message link switch. Total flexibility in parallel application topologies giving optimum match of machine to problem.
- System health monitoring and run-time diagnostics are directly supported by Meiko's proprietary System Supervisor VLSI chip incorporated with each individual processor.
- High performance interfacing to the Sun windows and fileserving environment is ensured by the use of further dedicated T800 Transputers with dual ported shared memory in the Sun VME address space.

Applications Processors

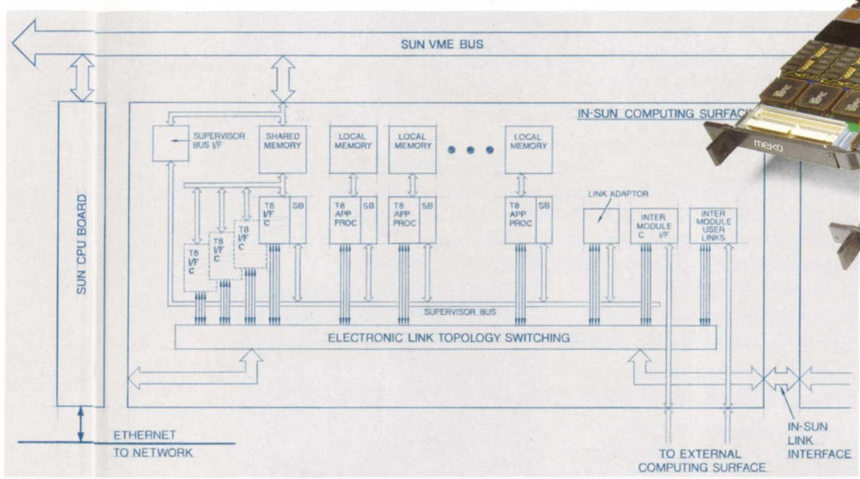
- ***Inmos T800 Transputer***
  5 VAX MIPS integer performance
  1.0 MFLOPS sustained double precision
  1.5 MFLOPS sustained single precision
- ***Field upgradeable Memory System options***
  1-12 MBytes memory per processor
  20 MBytes/s processor access rate
  parity and address range error checking
- ***Interprocessor message passing links***
  4 full-duplex channel pairs, each
  1 MByte/s per direction
  8 autonomous DMA message passing engines
  Hardware flow control protocols
  Automatic thread synchronisation and scheduling
- ***System Supervisor***
  Automatic monitoring and reporting for run-time and memory system errors
  Dedicated independent path for diagnostics and symbolic debugging

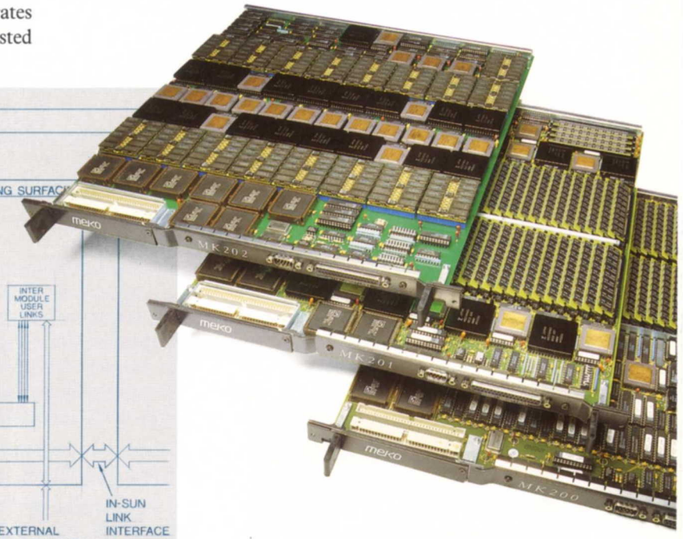


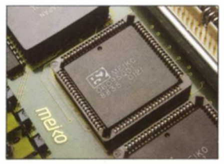
VME Interface Controllers

In-Sun Computing Surface boards have from one to four T800 processors dedicated to managing the interface between individual application processors and the host environment. These interface processors have a shared memory system of up to 4 MBytes of multi-ported RAM. 1 MBytes of this memory system is dual ported to the VME bus. The operation of the interface is entirely transparent to users and programmers, supporting data transfer rates of 2.2 MBytes/s to the Sun filing system and Sun hosted application front ends.

The message links from interface processors are connected via the Message Link Switch giving routes between the Sun environment and all of the individual application processors anywhere within the Computing Surface. That is, to processors on the same board, on other boards within the Sun chassis, or within an attached Computing Surface module.







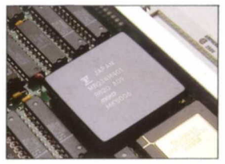
Message Link Switch

The Computing Surface Message Link Switch is a software controlled routing network allowing complete flexibility of interconnection between processor message links. The switch is non-blocking, and transfers messages at high-speed with low end to end latency. Message paths through the switch all operate at 20 MBits/s simultaneously.

By providing this architectural keystone, Meiko has avoided the limitations of fixed topology multi-processor machines. Applications specify machine topology configurations at run-time; for example, trees, grids, n-cubes, rings, and toroids.

In-Sun Link Highway

The Link Highway allows the In-Sun Computing Surface to grow seamlessly, allowing multiple boards to be combined inside the Sun workstation chassis. The Link Highway is the means by which the Message Link Switch extends transparently across board edges. It is entirely enclosed within the electrical environment and chassis of the host machine.



System Supervisor

Meiko's unique System Supervisor is a global communications bus which operates independently from the inter-processor message passing architecture. It is designed to handle system housekeeping functions essential to providing serviceable multi-user facilities. Direct control over individual application processors allows selected groups of processors to be reset and reloaded without disturbing the rest of the community.

Processor run-time error, and memory address violation, detection and reporting, along with application monitoring and run-time symbolic debugging support from within the Sun environment greatly facilitate the application development cycle.

Memory system failure detection and reporting are prerequisites to system confidence and maintenance activities.

The System Supervisor functions are implemented using one Meiko proprietary VLSI chip per processor. Hardware detected error conditions initiate messages over the supervisor bus as an automatic function of this chip.

Application diagnostics and symbolic debugger handlers address the System Supervisor as a memory mapped device.

In-Sun Computing Surface: Configurations

In-Sun Computing Surface Systems offer up to 96 processors embedded in a single workstation, yielding from 20 to 400 VAX MIPS and 6 to 150 MFLOPS, matched by memory system options of up to 512 MBytes.

Meiko provides an entire family of In-Sun products, these may be supplied as complete Sun workstations with the MK 200 series Computing Surface installed and configured for use. Alternatively MK 200 systems are available separately for installation in customers existing Sun 3 or Sun 4 machines.

Turnkey Systems

PORTABLE PARALLEL APPLICATION DEVELOPMENT STATION

Based on the Sun SPARCstation 330 with MK 203 Computing Surface, this package provides a low entry cost development capability.

The host unit provides a Sun SPARC CPU with 8 MBytes of memory, 327 MBytes disc drive and 19" monochrome monitor. A 150 MBytes tape backup unit is available for standalone installations.

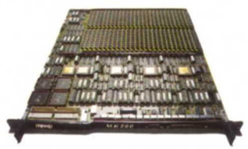
Up to four networked users can simultaneously share the parallel computing facilities, available as system options with four, eight, or sixteen application processors. The smaller parallel configurations may subsequently be scaled to increase performance, with customer installable upgrade packages, in units of four processors. One spare 9U expansion slot is left for further installation upgrades.

SUPER POWER COLOR WORKSTATION

True Supercomputer performance is provided by 40 processors, 320 MBytes of memory configuration installed in the desk side pedestal of a SPARCstation 370. Accelerated graphics, using Sun GX technology to deliver 200,000 3D vectors/s, mean that this workstation can be applied to interactive visualisation applications directly coupled to computationally intensive modellers.

The host system provides 16 MIPS/2.6 MFLOPS CPU plus 327 MBytes disc and 150 MBytes tape storage.

The Computing Surface component delivers around 200 VAX MIPS/60 MFLOPS in the form of five MK 201 boards, while for less memory intensive applications five MK 202s give 400 VAX MIPS/120 MFLOPS.



MK 200

20 VAX MIPS

Four applications processors each with up to 12 MBytes memory, delivering up to 20 VAX MIPS/6 MFLOPS parallel processing performance

MK 201

40 VAX MIPS

Eight applications processors each with up to 8 MBytes memory, delivering up to 40 VAX MIPS/12 MFLOPS parallel processing performance

MK 202

80 VAX MIPS

Sixteen applications processors each with up to 2 MBytes memory, delivering up to 80 VAX MIPS/24 MFLOPS parallel processing performance

MK 203

20-80 VAX MIPS

Up to sixteen applications processors each with up to 2 MBytes memory, delivering up to 80 VAX MIPS/24 MFLOPS parallel processing performance. Processor and memory upgrade options.

Comprehensive Customer Support

Overview and Demonstration Sessions

Meiko provides regular technical overview and demonstration workshops for prospective users of Meiko systems who require detailed pre-purchase support. These serve as an introduction to parallel computing in general and the CS Tools development environment in particular. Case studies are used to provide insight into the process of solving real problems with this technology.

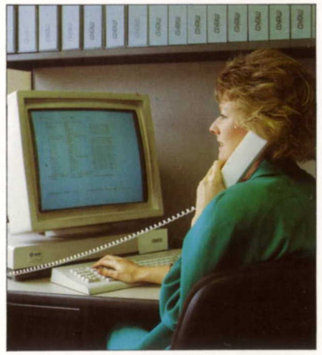
The sessions present an exellent opportunity for prospective clients to evaluate Meiko products and to discuss their particular requirements with appropriate specialists.

Intensive Training Workshops

These provide customers with the opportunity to hit the ground running, becoming quickly operationally productive upon installation. These hands-on training workshops enable users to become familiar with the system software, the software development environment and the physical hardware before actual delivery.

Applications Support

Meiko holds regular applications training workshops in aspects of parallel computing. These range from introductory sessions covering parallel systems programming to advanced workshops on application design, decomposition techniques, algorithm development and large systems management. They are given to specific user requirements and are conducted in Boston, USA and Bristol, UK but are also available on-site at customers facilities.



Hotline Telephone Support

Providing customers with a direct hotline to Support Centres for software and hardware support and problems needing immediate response.

On-Site Maintainance Program

Meiko is committed to providing customers with high quality and timely support services. These include system installation, emergency repair and field upgrades. Maintenance support details are available in the Meiko Customer Services Agreement.

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IN NORTH AMERICA

Meiko Scientific
Reservoir Place, 1601 Trapelo Road
Waltham MA 02154

Telephone: 617 890 7676
Fax: 617 890 5042

IN EUROPE

Meiko Scientific
680 Aztec West
Bristol BS12 4SD

Telephone: 0454 616171
Fax: 0454 618188