The Meiko CS-2 System Architecture

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Abstract

During the lifecycle of Meiko's first range of Computing Surface products, achievable performance has increased by almost three orders of magnitude – always at the leading edge. Now Meiko has introduced a new product range, the CS-2; an MPP supercomputing system designed to meet the challenges of HPC throughout the 1990s.

1 Introduction

CS-2 is Meiko's second generation MPP supercomputer system, designed to support user communities in open systems environments and focus more power on single problems than ever before. CS-2 systems combine low-latency scalable communication with leading SPARC super-scalar and Fujitsu vector processing. Every facet of the CS-2 is scalable. CPU performance, memory bandwidth, inter-processor communication bandwidth and I/O system performance all scale so that the same applications can run on a small development machine or on a large production system without compromising efficiency.

2 Scalable Supercomputing Architecture

CS-2 is a distributed global memory architecture. Every processing element (PE) has one or more CPUs, its own local memory system and is capable of operating independently. The distributed memory architecture guarantees a constant ratio of CPU performance to memory bandwidth whatever the size of system

CS-2 processors share data using a sophisticated and highly efficient communications network. Each PE has its own interface to this network, allowing it to access data held anywhere in the system. The bi-sectional bandwidth of the CS-2 data network grows linearly with the number of PEs

The CS-2 data network is a multi-stage switch network; a fat tree with constant bandwidth per stage. As the number of PEs grows, network stages are added to preserve bandwidth.

The CS-2 architecture provides a powerful file I/O system which is both flexible and scalable. Every PE is capable of managing its own independent I/O devices allowing, for example, large files to be accessed concurrently at full bandwidth from large numbers of processors simultaneously.

System Hardware. Every CS-2 PE uses a superscalar implementation of the SPARC microprocessor as its core CPU. On CS-2 Vector PEs the SPARC scalar processor is augmented by two Fujitsu μVP vector units. Each vector PE is capable of a peak performance of 400 32-bit Mflops and 200 64-bit Mflops.

Each CS-2 PE has its own intelligent network interface. This is implemented by a custom designed VLSI component. This contains a hardware DMA engine for high speed data transfer, virtual memory translation hardware and an embedded RISC processor dedicated to executing communications protocols.

CS-2 systems are modular in construction, providing flexible configuration options and component redundancy. The basic building block is a module containing processor boards, switch network boards or mass storage devices. All systems, whatever their size, are constructed from the same processor and switch network boards.

System Software. The CS-2 operating system is based on Sunsoft Solaris conforming with the SPARC ABI, X/Open Portability Guide 3, System Five Release 4 (SVR4), and POSIX P1003.1 (1990) standards.

The CS-2 resource management suite extends standard UNIX to support production execution of parallel applications. It includes the access control, accounting, administration, batch processing and utilization tools necessary to manage a massively parallel system.

CS-2 systems support the principle paradigms for the development of parallel applications; SPMD programming utilising HPF (High Performance Fortran), Message passing using interfaces such PARMACS, PVM and Meiko CSTools.

The CS-2 application development environment includes compilers for Fortran-77, ANSI C, Fortran-90 and HPF together with a wide variety of tools for instrumenting, analyzing, debugging and parallelizing programs.

3 Summary

The Meiko CS-2 has been designed to operate in production and scientific programming environments, providing support for any mix of application codes be they sequential or parallel, scalar or vector. The use of standard commodity components and adherence to industry standards maximises the price/performance benefits available to Open Systems and parallel programming customers alike. The modular architecture offers linear scalability in performance and capability from development machine to large production system and Meiko has incorporated a designed-in approach to fault tolerance ensuring the highest levels of system reliability and availability.

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